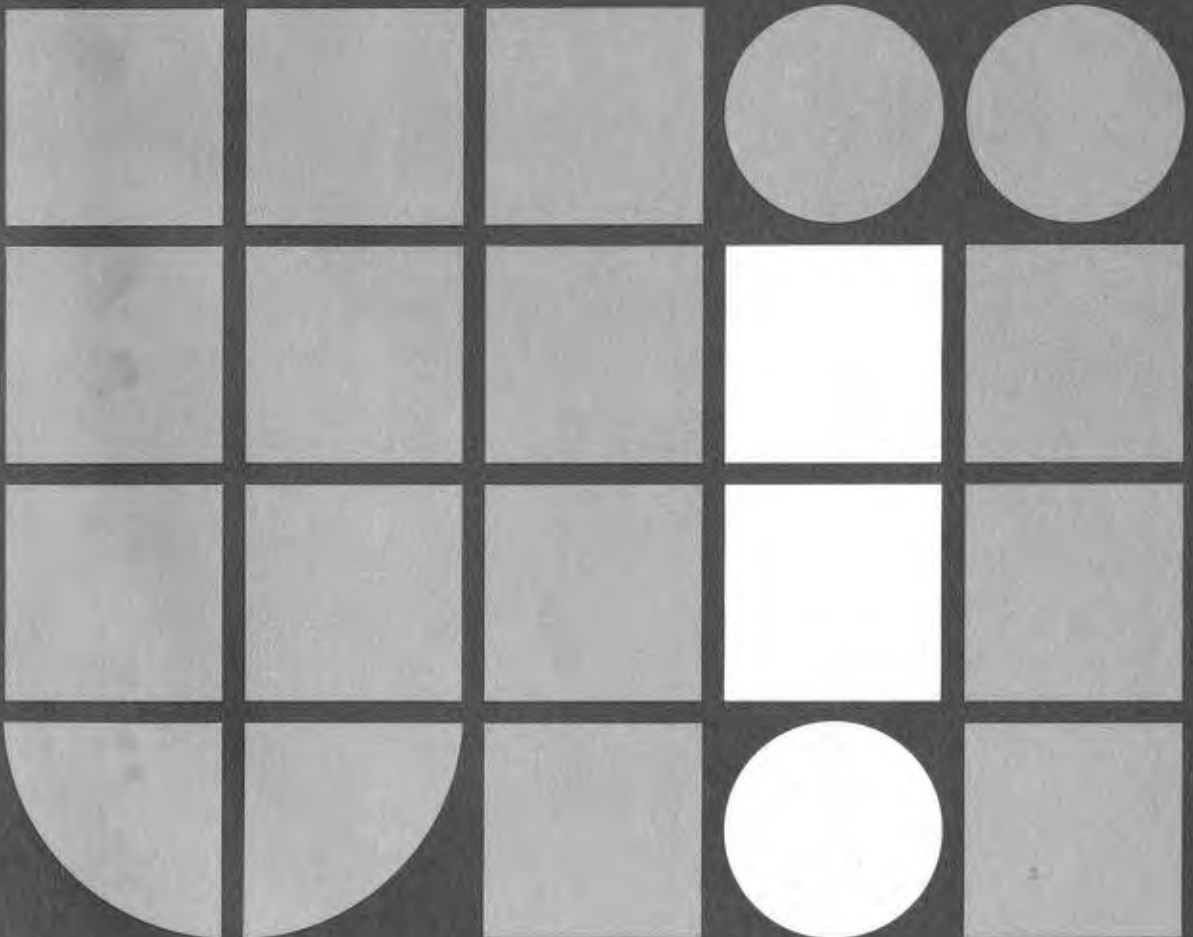


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University of
Rhode Island
1973•74

Graduate School
Bulletin



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The University

The University of Rhode Island, a land-grant institution founded in 1892, is located on 1200 acres in the village of Kingston, 30 miles south of Providence and six miles from the ocean. In 1971 it became one of four sea grant colleges in the United States. The faculty numbers about 800, and there are about 2300 graduate and 8200 undergraduate students enrolled. Approximately one-half of the graduate students are in full-time residence.

The university is made up of eight colleges and three schools: the Colleges of Arts and Sciences, Business Administration, Engineering, Home Economics, Nursing, Pharmacy, and Resource Development, the University College, the Graduate School, the Graduate Library School and the Graduate School of Oceanography.

The Division of University Extension in Providence enrolls about 5500 students in credit courses. The Master of Arts in English, the Master of Business Administration, and the Master of Public Administration degrees may be earned in the Division of University Extension as well as on the main campus.

The 2300-acre W. Alton Jones Campus, where research and conference facilities and a Youth Science Center are located, is 20 miles from Kingston in West Greenwich.

The Graduate School of Oceanography is located on the 165-acre Narragansett Bay Campus, six miles from Kingston on the west shore of Narragansett Bay within easy reach of both bay and open ocean. Major buildings include the Charles J. Fish Laboratory, the Claiborne Pell Marine Science Library, the Francis H. Horn Research Laboratory, a research aquarium, and a number of smaller laboratory and

research facilities. The campus also includes the state of Rhode Island's atomic reactor and federal laboratories devoted to the marine sciences. A marine experiment station is located on the saltmarsh at Jerusalem, Rhode Island.

The University of Rhode Island is an Equal Opportunity Employer.

ACCREDITATION

The accrediting agencies which have approved the quality of the course offerings of the University of Rhode Island include the American Association of Universities, the American Association of Collegiate Schools of Business, the American Chemical Society, the American Council on Pharmaceutical Education, the American Library Association, the Engineers Council for Professional Development, the National League for Nursing, the New England Association of Colleges and Secondary Schools, and the University of the State of New York.

The University is also an approved member institution of the American Association of University Women, the Council of Graduate Schools in the United States, the National Association of Schools of Music, the National Association of Summer Sessions, and the National University Extension Association. The Doctor of Philosophy program in clinical psychology is provisionally accredited by the American Psychological Association.

GRADUATE STUDY

The Dean of the Graduate School has primary responsibility for administering the policies and

procedures relating to advanced study at the University of Rhode Island. Graduate School policy is made by the Graduate Faculty, acting through its delegate body, the Graduate Council which includes student members. Only the Dean or the Graduate Council may grant exceptions to the regulations for graduate study, which are explained in detail in the *Graduate School Manual*.

Graduate study at the University was inaugurated in 1907 with the Master of Science degrees in chemistry and in engineering. The Master of Arts degree was first awarded in 1951 and in 1960 the University awarded its first Doctor of Philosophy degree. Graduate work for professional degrees was initiated in 1962 when the degree of Master of Public Administration was first awarded. Today, the master's degree is offered in over 65 areas of study and the doctorate in 24 areas.

GRADUATE DEGREE PROGRAMS

The University offers the programs of study listed below. Work in a combination of special areas is usually possible.

MASTER OF ARTS

Economics
Education
 Educational Research
 Elementary Education
 Guidance and Counseling
 Reading Education
 Science Education
 Secondary Education
 Youth, Adult and Community Education
English
French
Geography
History
Philosophy
Political Science
 International Relations
Sociology
Spanish
Speech Pathology and Audiology

MASTER OF SCIENCE

Accounting
Animal Pathology
Animal Science
Biochemistry
Biophysics
Botany
Business Education

Chemical Engineering
Chemistry
Child Development and Family Relations
Civil and Environmental Engineering
Computer Science
Electrical Engineering
Environmental Biology
Environmental Health Sciences
Experimental Statistics
Food and Nutritional Science
Food and Resource Chemistry
Geology
Home Economics Education
Industrial Engineering
Mathematics
Mechanical Engineering and Applied
 Mechanics
Medicinal Chemistry
Microbiology
Nuclear Engineering
Nursing
Ocean Engineering
Oceanography
Pharmacognosy
Pharmacology and Toxicology
Pharmacy
Pharmacy Administration
Physical Education (men and women)
Physics
Plant and Soil Science
Plant Pathology-Entomology
Psychology (school)
Resource Economics
Speech Pathology and Audiology
Textiles, Clothing and Related Art
Zoology

DOCTOR OF PHILOSOPHY

Biological Sciences
 Animal Pathology
 Biochemistry
 Biophysics
 Botany
 Food and Resource Chemistry
 Microbiology
 Plant Pathology-Entomology
 Zoology
Chemical Engineering
Chemistry
Civil and Environmental Engineering
Economics, Marine Resources Option
Electrical Engineering
 Biomedical Engineering
English
Mathematics
Mechanical Engineering and Applied
 Mechanics

Ocean Engineering
 Oceanography
 Pharmaceutical Sciences
 Medicinal Chemistry
 Pharmacognosy
 Pharmacology and Toxicology
 Pharmacy
 Physics
 Psychology

PROFESSIONAL DEGREES

Master of Business Administration (M.B.A.)
 Master of Community Planning (M.C.P.)
 Master of Library Science (M.L.S.)
 Master of Marine Affairs (M.M.A.)
 Master of Public Administration (M.P.A.)

RESEARCH

Active research programs are carried on throughout the University and are supported by foundations, commercial firms, the United States government and the University. Specialized research is carried on in the several areas described below.

THE AGRICULTURAL EXPERIMENT STATION

The station, established in 1888, is concerned with basic and applied investigation in natural and human resources. This research aims to conserve and manage resources, improve the quality of environments, abate pollution and recycle waste materials, enhance rural environments, develop more rewarding home life, and support resource-using industry and business in the region. Research is conducted in food and resource chemistry, resource economics, plant and soil science, plant pathology-entomology, forest and wildlife management, animal science, and animal pathology. A strong orientation to estuarine and marine problems, and an interdisciplinary approach to resource research are station characteristics.

THE BUREAU OF GOVERNMENT RESEARCH

The bureau was organized in 1960 to provide service to municipalities and to the state. The bureau maintains a municipal consulting service which assists Rhode Island communities in dealing with problems of governmental organization and administration. It has a publications program including a research series, an information series, and a monthly newsletter, and operates a program of conferences and awards. The bureau assists in the administration of the grad-

uate program in public administration, and maintains a public administration library and an information service for local government units.

THE DIVISION OF ENGINEERING RESEARCH AND DEVELOPMENT

The division was established in 1942 to coordinate the research activities of the College of Engineering. It disseminates the results of basic or fundamental investigations; conducts fundamental and applied research projects; provides opportunities for graduate students and highly qualified undergraduates to participate in research studies; and offers opportunities for members of the engineering faculty, through research, to keep abreast of advances in the profession. Facilities are available for research in the fields of chemical, civil, electrical, industrial, mechanical, materials, nuclear, environmental and ocean engineering.

THE INSTITUTE OF ENVIRONMENTAL BIOLOGY

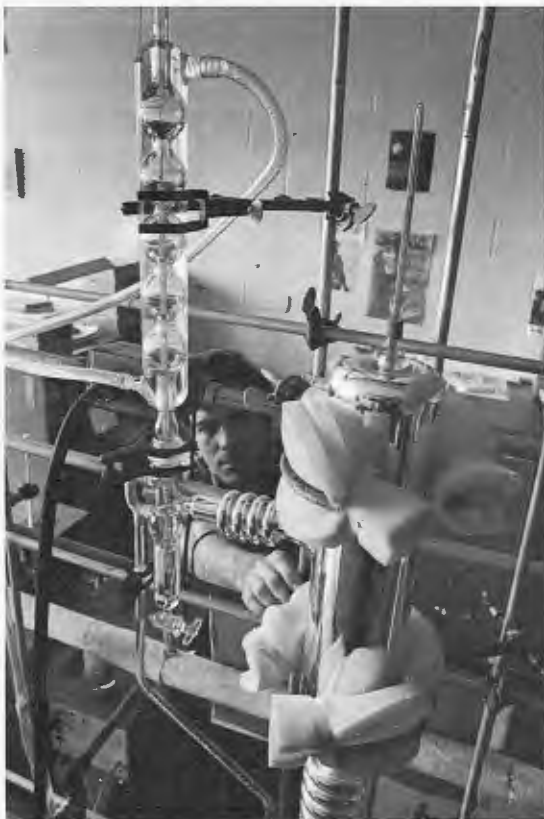
The institute is an administrative organization consisting of faculty members active in graduate training and research in botany, electrical engineering, forestry, oceanography, pharmacology, and zoology, and of adjunct faculty members in associated federal and private laboratories, who provide an interdisciplinary approach to problems in environmental biology.

LABORATORIES FOR SCIENTIFIC CRIMINAL INVESTIGATION

These laboratories in the Department of Pharmacology and Toxicology of the College of Pharmacy provide instruction, research, and service in the field of scientific criminal investigation. The laboratory staff works closely with the Rhode Island Attorney General's Office and also provides technical consultation for various law enforcement agencies, and special instruction and research in criminalistics, in which faculty members of various departments participate. The program sponsors a special course for police and law enforcement agencies.

MARINE RESEARCH PROGRAMS

A number of marine research programs are carried on at the University and are coordinated under the Provost for Marine Affairs. These include basic and applied research in the several areas of physical, chemical, geological and biological oceanography within the Graduate School of Oceanography.



The *Sea Grant College Program*, started in 1968 with funds from the Sea Grant College and Program Act of 1968, encompasses specialized marine research, education and public service projects in many departments of the University. Both the *URI Marine Advisory Service*, which provides marine extension services in the state, and the *New England Marine Resources Information Program*, which does the same in New England, are based at the University and are part of the Sea Grant Program.

With initial support from the Agency for International Development, the University in 1969 created the *International Center for Marine Resource Development* to assist developing countries in using food and other resources from the sea.

The *Law of the Sea Institute*, established in 1965, conducts summer conferences designed to elucidate legal and jurisdictional problems in ocean resource exploitation. It is administered through the University and directed by a board composed of specialists drawn from various parts of the country.

The *Coastal Resources Center*, established in 1971 to assist the Rhode Island Coastal Resources Management Council in preparation of coastal and marine management plans for the state and its political subdivisions, is based at the University.

THE RESEARCH CENTER IN BUSINESS AND ECONOMICS

The center, established in 1965, coordinates the research activities of the College of Business Administration. The center initiates, conducts, and services research activities of the faculty in the fields of accounting, business education and office administration, business law, economics, finance, insurance, management science, marketing management, organizational management and industrial relations, and production and operations management.

THE RHODE ISLAND WATER RESOURCES CENTER

This is the state center for research and training in all phases of water resources. Similar centers in each of the 50 states and Guam, Puerto Rico and the Virgin Islands were established by law in 1964 and work cooperatively with the federal government in an effort "to assist in assuring the nation at all times of a supply of water sufficient in quantity and quality to meet the requirements of its expanding population." Principal investigators of projects need not be employed at the University.

THE UNIVERSITY LIBRARY

The library, centrally located on the campus, is a four-level, air-conditioned building designed to accommodate almost half a million volumes and to provide the most advanced facilities for study and research. The open-stack arrangement permits direct access to the collection of approximately 451,000 books, periodicals, documents, manuscripts, microfilms and microcards. Annual growth is about 40,000 volumes per year. Special collections are devoted to rare books, Rhode Island history, local authors and University history. Approximately 130,000 volumes classified in the Dewey system are housed in Rodman Hall.

Specialized libraries are located in Pastore Chemical Laboratory and in the Pell Library of the Graduate School of Oceanography.

The Pell Library contains a wide collection of books and periodicals on the marine sciences and reports of major oceanographic expeditions, making it one of the most complete marine science libraries on the east coast. It has been designated the National Sea Grant Depository. The building also houses a remote computer console linked with the Computer Laboratory.

RESEARCH RESOURCES

The Computer Laboratory has an IBM system/370 model 155 with 1024K of high speed storage, disk storage units, magnetic tape, card, and printer input/output devices, and an off-line plotter. The system's hardware and software accommodate both remote batch and interactive terminal usage as well as normal batch processing. Intermediate-speed remote batch terminals are installed within the Graduate School of Oceanography and the Department of Civil and Environmental Engineering. The Department of Electrical Engineering has two PDP-9 computers with a graphics display console linked to the Computer Laboratory's system. A Nova 1200 computer with a 16 channel A to D converter and Versatec printer-plotter located in the Department of Ocean Engineering has a magnetic tape input/output system compatible with the 370 system. The staff members of the Computer Laboratory, who are teaching faculty in the Department of Computer Science and Experimental Statistics, develop and maintain programming systems and application programs, and provide consultation in numerical methods, statistical analysis, and computational technique.

Computer graphics facilities, graphical input and output devices, are also located in the electrical engineering building. The chemical engineering building has an applied dynamics 32 PB analog computer, ultra-high pressure and

high-pressure temperature equipment that permits study of solid state under pressures of up to 80 kilobars and temperatures up to 2000°C, and a nuclear laboratory including counting equipment, multi-channel analyzers, and subcritical assembly.

Other equipment includes an off-line incremental plotter, a major laboratory for research on photo-electronic imaging devices, optical properties of materials and micro-electronics, electromagnetically shielded rooms for biomedical research, a field station for radio-propagation research, pressure chambers for leak testing equipment prior to deep-sea use, triaxial test chambers for soil and sediment testing, a newly-designed rotating basin for studying basic problems in oceanographic hydrodynamics, reverberant and anechoic rooms for airborne acoustics work, X-ray radiographs and spectographs, electron microscopes and scanning electron microscopes, a low-speed wind tunnel located in the mechanical engineering building for fluid mechanics studies, a large buoy to monitor Narragansett Bay pollution parameters and telemeter data to the Nova 1200 computer, an underwater acoustics test facility, Deep Ocean Sediment Probe (DOSP) for in-situ sediment measurements, a marine experimental aquarium located on Narragansett Bay Campus, and a mass spectrometer.

The University's research vessel, *Trident*, operated by the Graduate School of Oceanography, is a 180-foot ship capable of working in all parts of the world's oceans. It can carry a scientific party of 13 men and women, can work continuously at sea for 60 days and provides one of the largest laboratory areas of any United States research vessel. Two 45-foot motor cruisers, *Gail Ann* and *Crowsnest VI*, are part of the permanent fleet and a 40-foot dragger, *Billie II*, is chartered on a year-round basis for work in Narragansett Bay and Rhode Island Sound.

Students at the University have a research reactor and associated facilities available to them at the Rhode Island Nuclear Science Center, located on the Narragansett Bay Campus. Constructed and operated by the state of Rhode Island, this critical reactor is extensively used for research by many departments of the University. The reactor, designed for 5MW, is now operating at 2MW. A subcritical reactor is located on the main campus.

GRADUATE LIFE

Students find unique advantages at a University located in a small village in the heart of the northeastern Megalopolis. Cultural variety and

compact size are combined in the state of Rhode Island, and other cultural centers are easily accessible. Boston is 80 miles to the north and New York City 160 miles southwest. Direct bus service to these cities, as well as to Providence, Newport and Cape Cod, is available from the campus. The Kingston station of the Penn Central railroad is two miles away.

SERVICES

The recreational and cultural facilities of the campus are open to graduate students, including use of the Memorial Union building. Facilities there include meeting rooms, lounges, bowling lanes, billiards, table tennis, the University Bookstore, cafeteria, and snack bar. Services include an information center, barber shop, bank, travel agency, laundry pickup station, Western Union office, record and art print libraries, and student pub serving wine and beer.

Every effort is made to provide graduate students with opportunities for consultation and advice on matters of concern to them in their academic, extracurricular and personal lives. Descriptions of available services and facilities, including those associated with religious life, may be found in the *Undergraduate Catalog*. Of particular

interest to graduate students are the following: Career Planning and Placement, 80 Lower College Road; Counseling Center, Roosevelt Hall; Health Service, Potter Building; Housing Office, Roger Williams Complex; International Student Affairs, Taft Hall; Religious Counselors, Memorial Union and Catholic Center; Student Aid Office, Davis Hall.

UNIVERSITY OMBUDSMAN

The ombudsman investigates complaints from students, faculty and administrative personnel that they have been unfairly dealt with in the normal channels of administrative process. An opportunity is thus provided for a personal appeal to an impartial official with broad perspective who has ready access at all levels to those involved in a grievance. The ombudsman is always available to receive complaints, inquire into the matters involved and mediate or otherwise resolve the problem. He does not, however, concern himself with the normal operations of established procedures as outlined in the *Graduate Student Manual* except where it appears to him that they are not functioning as intended.

The ombudsman, Robert S. Haas, and his student assistant, Kurt Kouffman, have an office in the Memorial Union.



SERVICES FOR THE DISADVANTAGED OR HANDICAPPED

The Dean of the Graduate School, the Director of Career Planning and Placement, the Director of Counseling, and the Director of the (undergraduate) Special Program for Talent Development cooperate to provide information and guidance for economically and socially disadvantaged individuals seeking opportunities for graduate study at the University. Inquiries may be directed to any of these offices. A number of Department of Housing and Urban Development fellowships are available for members of minority groups accepted into the Master of Community Planning program.

Special counseling for physically, psychologically, or vocationally handicapped individuals is available from the Director of Counseling.

GRADUATE STUDENT ASSOCIATION

This organization is interested in both the academic and social aspects of graduate life. Officers and representatives of the association are elected annually from the entire graduate student body and the association is represented on the Graduate Council. The association publishes a newspaper, *The Grad Side*.

There are also organizations for wives of graduate students and for students from foreign countries.

LIVING ACCOMMODATIONS

A new housing complex and several older buildings provide 140 units of unfurnished apartments for graduate students. There is usually a waiting list for these and interested students should write to the University Housing Office for additional information and applications. The Housing Office also maintains a list of off-campus rooms, apartments, and houses which may be rented by graduate students. For these the use of a car is desirable. For further information on housing, including current costs, interested students should contact the Director of Housing, Roger Williams Complex.

Dining services are available for graduate students and their guests at any of the University dining halls. The Ram's Den in the Memorial Union provides additional services. Students desiring University board must sign a semester

contract based on a 15-meal week (three meals per day, Monday through Friday). Current costs and other specific information may be obtained from the Director of Dining Services, Lippitt Hall.

ARMY ROTC

A new two-year program has been designed to fill the needs of graduate students who have not taken Army ROTC during their undergraduate years. The United States Army offers the opportunity to earn commissions as second lieutenants after two years of on-campus ROTC training. The student attends a six-week basic summer camp after graduation with the bachelor's degree and completes the advanced ROTC course while attending graduate school.

ACADEMIC AND SOCIAL CODES

Each student is a member of the University community with all the rights, privileges and responsibilities that go with such membership. The rights and privileges include full use of the educational opportunities and facilities offered on the campus. The responsibilities include those of making proper use of these facilities in order to progress educationally, of respecting the rights of others, and of knowing and obeying the rules and regulations developed by the University community for the good of the total membership.

The University expects that all course papers, theses and dissertations will be prepared and all examinations taken in conformance with accepted standards of academic integrity. This includes the proper citation and attribution of all material which is not the original product of the writer. It is the graduate student's responsibility to determine the appropriate style used in his or her discipline for presentation of material derived from other sources and to adhere to it scrupulously in all written presentations. Where no special disciplinary style exists, that given in Kate L. Turabian's *A Manual for Writers of Term Papers, Theses, and Dissertations*, published by the University of Chicago Press, should be used.

NOTICE OF CHANGE

Rules, regulations, dates, charges, and fees set forth in this catalog are subject to change without notice.



Degree Requirements

Each advanced degree awarded by the University requires as a minimum the successful completion of a specified number of approved credits of graduate study at the University and the passing of prescribed examinations. Credit hours for a master's or doctoral degree may include formal course work, independent study, research, preparation of a thesis or dissertation, and such other scholarly activities as are approved by the candidate's program committee and the Dean of the Graduate School.

It is the student's responsibility to know the calendar, regulations and pertinent procedures of the Graduate School and to meet its standards and requirements. These are set forth in this catalog, the *Graduate Student Manual*, the *Statement on Thesis Preparation*, and other publications, all of which are available to graduate students at the Graduate School Office.

These documents govern both master's and doctoral degree programs. The manual gives detailed information on preparation of theses and dissertations, examination procedures, and responsibilities of major professors and program committees.

The requirements immediately following are *general requirements* for all graduate students. *Specific requirements* for individual programs are itemized in the section on Graduate Programs.

PROGRAM OF STUDIES

All degree candidates are required to prepare a program of studies with the guidance of their major professors (for master's degree programs)

or of their program committees (for doctoral programs) in accordance with the guidelines in the *Graduate Student Manual*. After the program has been approved by the major professor for master's degree candidates or program committee for doctoral candidates as specified in the manual, the program of studies is to be submitted for approval to the Dean of the Graduate School.

The purpose of the program of studies is to ensure that the student, at an early stage in his graduate study, organizes a coherent, individualized plan for his course work and research activities. It is expected that the successful completion of the student's program of studies along with collateral readings, research, etc., will enable him to demonstrate that he has achieved the high level of competence required of graduate students in their respective fields.

COURSE NUMBERING SYSTEM

All graduate courses are now numbered at the 500, 600, and 900 levels (though not all 900-level courses carry graduate credit). Courses numbered at the 400 level are for advanced undergraduates, but may, with approval and to a limited extent, be accepted toward meeting degree requirements at the master's level. For doctoral candidates who have completed the master's degree in the same field or one closely related, all program work must be at the 500- or 600-level. Candidates for the doctorate may receive up to 30 credits toward the minimum required for recent graduate work taken at other institutions if appropriate for the program and discipline.

SCHOLASTIC STANDING

Graduate work is evaluated by letter grades. All grades earned, however, will remain on the student's record and, unless the courses were approved for no program credit prior to registration, will be included in calculating the student's scholastic average. Only grades of A and B carry graduate credit for courses below the 500 level. In 500-, 600-, and 900-level graduate courses only grades of A, B and C will be credited toward the degree.

A grade of C or lower in courses numbered below the 500 level is considered a failing grade. In such cases of failure the course must either be repeated or else replaced by another course approved by the candidate's program committee and the Dean of the Graduate School. If a student receives more than one C in courses below the 500 level, his graduate status is subject to review by the Dean of the Graduate School.

Grades of D and F are failing grades in 500-, 600-, and 900-level courses and require immediate review of the student's status. Courses failed at this level must be repeated or else replaced by another course approved by the candidate's program committee and the Dean of the Graduate School.

The grades S (satisfactory) and U (unsatisfactory) will be used for courses of study involving research undertaken for the thesis or dissertation and for certain courses and seminars so designated. The letter I (incomplete) is used for excused unfinished work. Incomplete grades assigned to graduate students in May 1971 or thereafter may be removed within one calendar year by completion of the required work. If the grade of I (incomplete) is not removed within one calendar year, it will remain on the transcript but may not be used for program credit. Grades of S, U, and I are not included in the academic average.

For graduation an average of B (3.0 on a 4.0 scale) in all work is required, except for courses meeting entrance deficiencies or approved for no program credit prior to registration in the course. At any time when the student's record indicates unsatisfactory performance his status is subject to review. A student who fails to maintain satisfactory scholarship or to make acceptable progress in his program will be terminated as a graduate student.

MASTER'S DEGREE REQUIREMENTS

There are no major or minor area requirements for the master's degree. However, no de-

gree can be awarded for the accumulation of credits without a planned program of study. Courses for the degree are expected to be concentrated in the candidate's field of interest and related areas to produce a well-developed and coherent program which will meet his special objectives.

Requirements for the master's degree must be completed within a period of five calendar years, or seven calendar years with special permission of the department and the Dean of the Graduate School if the study is done on a part-time basis. The master's degree may be earned either through full- or part-time study or by a combination of the two. Candidates must take at least 80 percent of the credits required for the degree at the University of Rhode Island.

Some departments offer both a thesis and a non-thesis option while others offer only one plan. Please refer to the chapter on Graduate Programs for specific information on each program. The general requirements for these options are as follows.

THESIS OPTION

The minimum requirements for a master's degree are: (1) The successful completion of 30 credits, including 6 thesis research credits. (2) At the discretion of the department, the passing of written comprehensive examinations toward the end of the course work. (3) The submission of an acceptable thesis and the passing of an oral examination in defense of the thesis. Four copies of the thesis prepared in accordance with Graduate School requirements must be submitted to the Graduate School Office. A statement on preparation of theses is available from that office.

NON-THESIS OPTION

Depending upon departmental requirements, some master's degrees may be earned without a thesis. The minimum requirements for a non-thesis master's degree program are: (1) The successful completion of a minimum of 30 credits. (2) Registration in advanced seminars, practicums, internships, or other experiences useful to the student's future professional career. (3) Registration in one course which requires a substantial paper involving significant independent study. (4) The passing of a written comprehensive examination toward the end of the course work. Some departments may also require a final oral examination.

LANGUAGE

Although the Graduate School does not stipulate a language requirement for the master's degree, certain academic departments require proficiency in a foreign language.

PROFESSIONAL DEGREE REQUIREMENTS

Students should refer to the specific program requirements for professional degrees and consult with the appropriate dean or director.

DOCTOR OF PHILOSOPHY DEGREE REQUIREMENTS

The Doctor of Philosophy degree must be completed within seven years after passing the qualifying examinations or after first registering for work beyond the master's degree.

The requirements for the doctor's degree are: (1) The completion of a minimum of 72 credit hours of graduate study beyond the baccalaureate degree, of which a minimum of 42 credit hours must be taken at the University of Rhode Island. (2) Satisfying the residence requirement that the student must maintain full-time residence for at least two semesters, exclusive of summer sessions, while acquiring the last 42 credits for the degree. Residence is interpreted as full-time attendance on campus or in the Division of University Extension during a regularly scheduled semester. Study carried on elsewhere under a University adjunct professor or in a laboratory having University of Rhode Island affiliation may also qualify as residence. With the exception of faculty, graduate assistants, research assistants, and other employees of the University, no candidate for the doctorate may count, except by action of the Graduate Council, part-time study toward satisfying this residence requirement. (3) If required by his department, proficiency in one or more foreign languages and/or in an approved research tool. (4) The passing of a qualifying examination. (5) The passing of a comprehensive examination. (6) The completion of a satisfactory dissertation. (7) The passing of a final oral examination in defense of the dissertation. The department in which the student studies for the doctor's degree may or may not require a master's degree preliminary to, or as a part of, the regular course of study.

QUALIFYING EXAMINATION

This examination attempts to evaluate a stu-



dent's competence for continuing in his chosen field and pertinent related fields at the doctoral level. For students who hold the master's degree, or who have completed 30 credits of appropriate work at another institution, the qualifying examination may be waived by the Dean of the Graduate School upon unanimous recommendation of the student's program committee and the acknowledgement of the department chairman. If the examination is not waived, it must be taken prior to the end of the student's first semester at this University.

COMPREHENSIVE EXAMINATION

The student shall pass, not earlier than one-half semester before and no later than ten months after the completion of his program of formal course work, the doctoral comprehensive examination.

The comprehensive examination consists of two parts: written, requiring a minimum of eight hours; and oral, requiring not more than two hours. The student, with the approval of his program committee, applies to the Graduate School to take the examination. The oral examination committee includes the student's committee and two additional members of the Graduate Faculty appointed by the Dean of the Graduate School. One of the additional members represents a field of study allied to that of the student's concentration. The candidate's major professor arranges for and chairs the examination. Unanimous approval by the examining committee is required for passing the comprehensive examination.

A candidate whose performance fails to receive unanimous approval of either examining committee may, upon the committee's recommendation, be permitted one reexamination in the part or parts failed, to be taken only after an interval of at least ten weeks.

FINAL ORAL EXAMINATION

This examination is a defense of the disserta-

tion and is open to all members of the faculty and, generally, to all students. The examination,

LANGUAGE AND/OR RESEARCH TOOL

Each department, in cooperation with the Graduate School, is authorized to formulate and to amend its own requirements and methods of testing for competency in foreign languages and/or research tools (such as computer science). The department may, in turn, delegate this responsibility to the program committee for each individual doctoral candidate.

usually two hours long, is conducted by an examining committee comprised of the candidate's program committee and two additional graduate faculty members appointed by the Dean of the Graduate School. One of the appointed members will be designated by the Dean to chair the examination.

Unanimous approval of the examining committee is required for passing. If the candidate does not perform satisfactorily, the committee may recommend one reexamination under stated conditions.

THESES AND DISSERTATIONS

For the oral defense, a sufficient number of completed copies of the thesis or dissertation, in a form acceptable to each member of the examining committee and the Dean of the Graduate School, is required. After all changes and corrections have been made, four copies prepared in accordance with Graduate School and Library requirements must be submitted to the Graduate School Office. Four copies of an abstract, not to exceed 600 words, are also required.

Students are advised to consult the *Statement on Thesis Preparation and Instructions for Thesis Defense* available in the Graduate School Office and the most recent edition of Kate L. Turabian's *A Manual for Writers of Term Papers, Theses, and Dissertations* published by the University of Chicago Press.

Admission and Registration

ADMISSION

Persons holding the baccalaureate degree and wishing to take graduate-level courses at the University may do so through admission to the Graduate School as degree candidates or may be accepted for postbaccalaureate work as non-degree students. Admission to the Graduate School is based upon academic qualifications and potential without regard to age, race, religion, sex or national origin.

Application forms may be obtained from the Dean of the Graduate School, University of Rhode Island, Kingston, Rhode Island 02881. Zip code should be included in the applicant's return address. Inquiries concerning particular degree programs or courses of instruction should be addressed to the appropriate department chairman.

Applications and credentials are to be submitted to the Dean of the Graduate School who, after obtaining the recommendation of the department concerned, notifies the applicant of either full or conditional admission, or rejection. Final decision rests with the Dean of the Graduate School.

All applications must be accompanied by a \$12 non-refundable application fee. Simultaneous application to more than one department requires duplicate applications and credentials and separate application fees.

General deadlines for receipt of applications and all supporting documents are April 15 for September or Summer Session admission, and November 15 for February admission. As is indicated in the Graduate Programs section of this catalog, certain programs admit students only for September and/or have earlier deadlines.

There is no assurance that applications received after these dates will be processed in time for enrollment in the desired semester.

FOREIGN APPLICANTS

Applicants from foreign countries must complete the Test of English as a Foreign Language (TOEFL) with minimum scores of 500 for science students and 550 for non-science students. All inquiries from foreign students concerning applications, fees, housing, etc., should be sent to the Director for International Student Affairs, Taft Hall.

TRANSFER CREDIT

Transfer credit may be requested for graduate work taken at other accredited institutions of higher learning. Such credits may not exceed 20 percent of the total credits required for the master's degree program or 30 credits in a doctoral program. The transfer work must have been taken at the graduate level (equivalent to the 500 level or higher in the University of Rhode Island course numbering system) and graded as **B** or higher, must have been completed not more than five years prior to the date of request for transfer into a master's program (ten years for the doctoral program), and must have a clear and unquestioned relevance to the student's program of study. The request for transfer credit must have the approval of the student's major professor and the Dean of the Graduate School. If transfer credit is desired for work taken elsewhere after a graduate student is enrolled at this University, *prior* approval must be obtained from the Dean of the Graduate School.

DEGREE CANDIDATES

Applicants must forward to the Dean of the Graduate School two completed application forms, two official copies of transcripts of all previous college work sent directly by the issuing institutions, three letters of recommendation and scores in the appropriate nationally administered tests. Tests required for specific programs may be found in the Graduate Programs section of this catalog.

For acceptance on full status in the Graduate School, in addition to satisfactory test scores and references, applicants should have maintained an undergraduate average of approximately B (3.0 on a 4.0 scale). Applicants with undergraduate averages below this level, but not less than 2.0, may be admitted to conditional status upon the submission of high test scores. Such persons will be admitted to full graduate standing upon the completion of the equivalent of one semester of full-time work with a grade average of B or better. No student may remain on conditional status for more than two consecutive semesters.

In certain cases, applicants who have been denied admission may be advised to take several courses in non-degree status (see below) to provide a basis for a later reconsideration of their applications. In such cases, these courses are usually regarded as entrance deficiencies and are not accepted for advanced standing within minimum-credit programs of study.

NON-DEGREE STUDENTS

Non-degree students are those who desire registration with credit in courses during a regular academic year and who are not seeking an advanced degree. Non-degree students do not have the privileges regularly enjoyed by degree candidates. For example, their enrollment in courses is subject to the accommodation of degree candidates wishing to take those courses. No more than a total of 12 credit hours of work taken at the University of Rhode Island in non-degree status may be applied toward degree requirements if the student is later admitted to a degree program, and then only upon recommendation of the student's program committee and with the approval of the Dean of the Graduate School. Advanced standing for work taken at another institution must also be included within this limit as well as within those described above for transfer credit.

Applicants seeking acceptance in non-degree status must file the regular application for admission and submit the required transcripts. They need not, however, submit letters of recommendation or scores on nationally administered tests

until such time as they may wish to apply for admission to a degree program.

REGISTRATION

The responsibility for being properly registered rests with the student. Each student must register and complete his registration within the time period announced by the University. The chairman of the student's major department will assign an adviser to assist the new graduate student in planning his program.

Registration for each semester consists of three separate procedures: registering for course selections, payment of fees, and obtaining a class program.

REGISTERING FOR COURSE SELECTIONS

Students must obtain registration materials at the announced time and place. Currently enrolled students register in November for the spring semester and in April for the fall semester. Completed registration materials are submitted to the Registrar during the registration period, according to the announced instructions.

New and transfer students will be instructed concerning registration procedures.

PAYMENT OF FEES

Arrangements must be made with the Bursar for complete payment of tuition and/or fees by the due date. Class programs will be issued only for those students who have registered for course selections, and satisfied payment requirements with the Bursar.

CLASS PROGRAMS

Students may not attend classes without class programs. These are issued prior to the first day of classes according to instructions from the Office of the Registrar.

DROP AND ADD

During the two-week period after the beginning of classes (drop and add period), students may adjust their schedules after obtaining the class program. Courses may not be added after the two week add period. Courses may be dropped until mid-semester. Courses dropped after the add period will incur a charge of \$5. In any course dropped after mid-semester, the instructor must submit a final grade.

CHANGE OF ADDRESS

It is the responsibility of the student to complete a change of address form in the Office of

the Registrar whenever a change is made in his local, campus, or mailing address.

SUMMER SESSION

Although many graduate-level courses are offered during the Summer Session, the University does not guarantee that any particular course will be offered. The availability of individual faculty members to supervise research or to participate in comprehensive examinations and examinations in defense of theses or dissertations during the Summer Session varies from year to year. During the Summer Session, special arrangements must be made with both the Graduate School and the department for scheduling comprehensive examinations and thesis or dissertation defenses. Graduate students must make prior, individual arrangements for taking directed studies or special problems courses, which require approval of the Dean of the Graduate School and the Dean of the Summer Session.

TIME LIMIT AND CONTINUOUS REGISTRATION

A graduate student is expected to complete his course work and research within the five-year time limit prescribed for the master's degree and the seven-year time limit for the doctorate. A student who has completed his course work and residence requirement is required to register and pay for Continuous Registration (CR) until his thesis or dissertation and all examination requirements are completed. A student must also be registered for either course work or CR during the semester in which he expects to complete all degree requirements. Upon application to the Dean of the Graduate School, the time limit for a degree program may be extended for such legitimate reasons as military service or serious illness. This request requires the endorsement of the student's major professor or department chairman.

See the *Graduate Student Manual 1973*, Section IV.B., for regulations regarding interruptions of study, notification requirements, and circumstances under which graduate students will be assumed to have withdrawn from the University.

FULL-TIME AND PART-TIME STUDENTS

The normal full-time registration is 12 credit hours of study during a regular semester. Minimum full-time registration is nine credit hours during a regular semester and six credit hours during a summer term. Full-time registration is required of all students holding fellowships, schol-

arships, and traineeships administered by the University. Students who do not meet the minimum full-time registration requirement are considered part-time students.

OFF-CAMPUS ACTIVITY

Students who wish to register for credits to be counted toward a degree, and who will be earning these credits through off-campus activities such as research or independent study at a national laboratory, are required to obtain prior approval of the Dean of the Graduate School and to have these activities listed as part of their programs of study.

INTELLECTUAL OPPORTUNITY PLAN (PASS/FAIL OPTION)

To allow graduate students to venture into new areas of knowledge without fear that their scholastic average will suffer, the Graduate Council has approved the Intellectual Opportunity Plan. To be eligible for this option, the student's major professor or adviser must certify that the course or courses are outside the student's major field of study, are not entrance deficiencies, and are not specific requirements of, but are relevant to, the student's program. A maximum of four credit hours may be taken by the master's degree candidate and a maximum of eight credit hours, including any taken as a master's candidate, by the Ph.D. candidate.

CREDIT BY EXAMINATION OR EQUIVALENT

In master's programs only, a maximum of six credits may be allowed for competency based on experience outside the traditional academic setting and demonstrated by examination or equivalent. This maximum of six credits must fit within an overall maximum of 12 credits including program credit allowed for advanced standing and transfer credit, if any. See the *Graduate Student Manual 1973*, Section IV.G., for details of this procedure.

AUDITING

Courses may be audited with the approval of individual course instructors and by presenting an auditor's card secured from the Registrar. An auditor receives no course grade; consequently, an audited course does not count as part of the student's course load for registration purposes, and cannot count as work taken toward completion of residence requirements.



Fees and Financial Aid

FEES

Charges and fees set forth in this catalog are subject to change without notice.

Tuition and fees vary according to whether or not the student is a legal resident of the state of Rhode Island and according to full-time or part-time enrollment. All charges are payable by the semester on receipt of the bill.

The Dean of the Graduate School classifies each student admitted to the University as a resident or nonresident student on the basis of all relevant information available to him. A Rhode Island resident must file with the Bursar a certificate of residence signed by the clerk of the Rhode Island city or town where he claims legal residence. A student may appeal the decision to the Board of Residence Review.

NEW ENGLAND REGIONAL STUDENT PROGRAM

Under the provisions of the New England Regional Student Program for graduate students, administered by the New England Board of Higher Education, the University charges the Rhode Island resident tuition rate to residents of another New England state who are matriculated graduate students in certain programs. The specific program must be one which is *not available* at the student's home-state university. To take advantage of this program, a resident of another New England state must obtain certification from the Dean of the Graduate School of his home-state university that the program of study is not available there. Applicants should, therefore, examine the pertinent catalogs and course offerings carefully. In cases where an apparently similar

program of study is available at both institutions involved, the certification will normally take the form of an endorsement by the Graduate Dean of a statement from the chairman of the relevant department of study. Inquiries and requests for further information may be directed to the Dean of the Graduate School at the University of Rhode Island or to the New England Board of Higher Education, 40 Grove Street, Wellesley, Massachusetts 02181.

SCHEDULE OF FEES

This schedule of fees is effective for the 1973-74 academic year. The University reserves the right to revise its schedule of tuition and fees without notice.

Full-time, One Academic Year. Students registered for 9 or more credits are considered full-time and are charged the following fees.

| | |
|-----------------------------|-------|
| Tuition | |
| Rhode Island residents | \$630 |
| Out-of-state residents | 750 |
| Graduate student assessment | 40 |
| *Medical insurance | 13 |
| Registration fee | 10 |

Part-time, One Semester. Students registered for 8 credits or less are charged the following fees.

* All full-time students are required to participate in the University's Student Medical Insurance Program unless they can give evidence of comparable coverage in another plan. This hospital plan has a \$20 deductible clause.

| | |
|-----------------------------|-------|
| Tuition, per credit hour | |
| Rhode Island residents | \$ 30 |
| Out-of-state residents | 35 |
| Graduate student assessment | 1 |
| Registration fee | 5 |

Students maintaining continuous registration and registered for no credit are required to pay a registration fee of \$30 per semester.

Division of University Extension. See the Division's Degree Programs bulletin.

Summer Session. See the Summer Session bulletin.

APPLICATION FEE AND ENROLLMENT DEPOSIT

Twelve dollars (\$12) must accompany each application for admission. See page 13 for application procedure.

Starting with the spring 1974 term, an enrollment deposit of \$30 will be required of each newly accepted student. This deposit, which is applied to the graduate student assessment or tuition, will be refundable provided that the Graduate School is notified in writing of intent to withdraw. Such notification must be received by January 5 for February 1974 admission, May 24 for June 1974 admission and August 15 for September 1974 admission.

ADDITIONAL FEES

Students may be asked to make key deposits and to cover laboratory and other incidental expenses for specific courses.

Master's degree candidates must pay a thesis-binding fee of \$4 and doctoral candidates must pay a dissertation-binding and microfilming fee of \$30. These fees are due before the candidate submits his dissertation for approval by the Graduate School. All degree candidates must pay a diploma fee of \$10.

REMISSION OF FEES

Remission of tuition and the registration fee is granted to holders of tuition scholarships, graduate assistantships and most fellowships and traineeships. This policy does not include graduate research assistants and associates whose stipends are normally larger than those of graduate assistants. The medical insurance fee and the graduate student assessment are both excluded from this remission policy.

REFUNDS

Refunds of payments made or credits against

amounts due to the University shall be made to students who officially withdraw according to the scale below. The attendance period in which withdrawal occurs is counted from the first day of registration and includes weekends and holidays.

| | |
|------------------|-----------|
| First two weeks | 80% |
| Third week | 60% |
| Fourth week | 40% |
| Fifth week | 20% |
| After five weeks | No refund |

FINANCIAL AID

There are several forms of financial assistance available to graduate students. To be eligible for any form of assistance, the student must first be admitted to the Graduate School. Detailed information (stipends, allowances, tenure, etc.) on the fellowships, scholarships, traineeships and assistantships described below is available from the Graduate School Office and is included in the *Graduate Student Manual*. Fellowships, traineeships, and scholarships are awarded by the Dean of the Graduate School to students selected from nominees submitted by department chairmen. Students are advised to request nomination for these awards by the chairman of the department in which they plan to study or are currently enrolled at the University.

FELLOWSHIPS

Fellowships are awarded to graduate students in recognition of achievement and promise as scholars. They are intended to enable students to pursue graduate studies and research without rendering any service to the University. A fellow's stipend is not considered compensation, but a gift. Graduate fellows are required to be full-time students and may not engage in additional remunerative work without the specific approval of the Dean of the Graduate School.

Special Fellowships are supported by various industrial firms, private foundations and individuals, and are usually restricted to students in particular areas of study and research. The stipends and supplemental allowances of these fellowships are not uniform.

University of Rhode Island Graduate Fellowships are supported by the Graduate School. A fellowship provides a stipend of \$3,000 for the academic year and the remission of tuition. This fellowship gives preference to promising students in recently established doctoral study programs where other fellowship support may not be available.

Public Health Service Predoctoral and Special Fellowships are provided to enhance the compe-

tence and increase the number of professional persons in the medical sciences and other health-related fields. These fellowships are awarded by the National Institutes of Health and by the Bureau of State Services Divisions of Nursing, Air Pollution, and Water Supply and Pollution Control. Applications for these fellowships are made directly to Career Development Review Branch, Division of Research Grants, National Institutes of Health, Public Health Service, Bethesda, Maryland 20014.

GRADUATE ASSISTANTSHIPS AND GRADUATE RESEARCH ASSISTANTSHIPS

Assistantships are awarded to full-time graduate students to provide them with teaching and research training. Assistants may be required to provide service for up to 20 hours per week. Appointments are initiated by department chairmen. To be eligible for such an appointment, the student must first be admitted to the Graduate School. His application for the assistantship should be submitted to the department chairman by February 15. Appointments are announced about April 1.

Graduate Assistants assist, under supervision, with instructional and/or research activities of a department. Not more than ten hours per week will be in classroom contact. Graduate assistant stipends for the 1973-74 academic year range from \$2800 to \$3200, depending upon qualifications and experience. In addition, tuition and the en-

rollment fee are remitted for the academic year of the appointment. Additional remuneration is given for any work done during the summer, although such work cannot be guaranteed.

Graduate Research Assistants are assigned to individual research projects sponsored either by the University or by an outside agency. On supported research contracts and grants, the graduate research assistant is judged to be employed on a half-time basis (for a 40-hour week). For this he receives a stipend ranging from \$3150 to \$4600 for nine months without remission of tuition and fees. Additional remuneration up to \$2666 is given for any work done during the summer months.

OTHER ASSISTANCE

Tuition scholarships, which provide for the remission of tuition and enrollment fees, are awarded by the Dean of the Graduate School from University funds. These scholarships are awarded to qualified students demonstrating need of financial assistance.

Loans for qualified students are available under the National Defense Education Act. Additional information is available from the Student Aid Office in Davis Hall, which administers loans.

Veterans' benefits information may be obtained from the Graduate School Office or from the Counselor for Veterans, Office of the Dean of Students in Green Hall.



Graduate Programs

This section must be read in conjunction with the preceding sections on Degree Requirements and on Admission and Registration. The specific admissions and program requirements listed below are included within the general requirements set forth in the preceding sections, and do not reduce those general requirements. For example, scores on the Verbal and Quantitative Aptitude Tests of the Graduate Record Examination (GRE) are required of all applicants unless another nationally-administered test such as the Admission Test for Advanced Study in Business (ATGSB) or the Miller Analogies Test (MAT) is specified below. Scores on the GRE Advanced (subject matter) Tests are required only where specified below.

Where admission to a doctoral program is possible for those holding the bachelor's degree and meeting other requirements, the Graduate School reserves the right to offer admission only to the master's program while postponing a decision on admission to the doctoral program until at least a substantial portion of the master's work has been completed.

Please note that the specific program requirements given on the following pages are minimum requirements. For example, additional course credits may be required for individual candidates whose academic background is insufficient.

ACCOUNTING

M.S., M.B.A.

GRADUATE FACULTY

Assistant Professor Martin, *acting chairman*. Professors G. W. Lees, Sanderson; Associate Professors Vangermeersch, Wood; Assistant Professors Brandon, duBois, Looney, Matoney.

MASTER OF SCIENCE

Admission requirements: undergraduate grade point average of B or above (2.7 on a scale of 4.0) and a score at the fiftieth percentile or above (approximately 475) on the ATGSB examination. Applicants for whom English is not the native language will be expected (in addition to presenting a TOEFL score of at least 575 as a condition for admission) to demonstrate proficiency in written and oral communications, or they will be required to correct deficiencies by taking selected courses for no program credit.

Program requirements: from 30 to 60 credits depending upon undergraduate program. A thesis is optional but the candidate is required to take GBA 671 if he elects the non-thesis option. A written comprehensive examination is required and an oral examination is optional at the discretion of the department.

MASTER OF BUSINESS ADMINISTRATION
See Business Administration program.

All 500- and 600-level courses offered by departments in the College of Business Administration are open to matriculated graduate students only.

ANIMAL PATHOLOGY

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY

Professor Yates, *chairman*. Professor Chang; Assistant Professors Kimball, Wolke; Adjunct Professors Dardiri, Liu.

SPECIALIZATIONS

Pathogenesis of avian adeno and bovine herpes viral infections in cells, embryos, and in avian and mammalian hosts; recovery of viruses from inland estuaries, streams and ponds; the genetic bases for resistance to the avian leucosis complex; diseases of fish.

MASTER OF SCIENCE

Admission requirements: GRE and an undergraduate major in biological science with a concentration in animal science, bacteriology, botany or zoology; mathematics through introductory calculus; quantitative analytical chemistry; and one year of organic chemistry and physics.

Program requirements: thesis and BCH 581, 582; APA 501, 502, 534, 536; MIC 432, 532, 541.

DOCTOR OF PHILOSOPHY (Biological Sciences)

Admission requirements: same as for master's degree.

Program requirements: courses listed under M.S. degree and APA 538; BPH 521; MIC 552, 544, 546.

ANIMAL SCIENCE

M.S.

GRADUATE FACULTY

Professor L. T. Smith, *chairman*. Associate Professors Cosgrove, Durfee, Henderson, Hinkson,

Kupa, Meade, Rand; Assistant Professors Gray, Millar; Adjunct Professor Coduri.

The department has two research facilities involved with studies in large animals, fish, poultry and game birds. It is involved in cooperative research in the Sea Grant Program, aquaculture: Food Science and Technology Program, gastric zymogens, food enzyme technology and food analysis in a joint program with the R.I. Department of Health. It is also involved in a joint program with the Department of Forest and Wildlife Management in areas of environmental control and wildlife management.

SPECIALIZATIONS

Food science, nutrition, physiology, genetics, aquaculture and wildlife management.

MASTER OF SCIENCE

Admission requirements: GRE. A bachelor's degree in agriculture or biological science is preferred.

Program requirements: thesis.

BIOCHEMISTRY

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY

Professor Purvis, *chairman*. Associate Professors Dain, Tremblay, Constantinides; Adjunct Professor Hammond; Assistant Professor Bell.

SPECIALIZATIONS

Mitochondrial metabolism and transport, comparative biochemistry of the cytochromes, biochemical aspects of endocrinology, neurochemistry, chemical embryogenesis of the nervous system and mechanisms of action of nervous tissue, glycolipid synthetic enzymes, regulation of protein synthesis, pyrimidine metabolism, control of blood coagulation, control of enzyme-activity.

MASTER OF SCIENCE

Admission requirements: GRE with preference given to students with undergraduate majors in chemistry, biology or biochemistry.

Program requirements: thesis and BCH 541, 581, 582; two semesters of seminar (elected from BCH 531, 532, 533, 534); and two courses elected from BCH 601, 602, 611, 612.

DOCTOR OF PHILOSOPHY (Biological Sciences)

Admission requirements: same as for master's degree plus passing qualifying examination at Ph.D. level. Master's degree not required.

Program requirements: courses listed under M.S. degree plus BCH 542; an additional two semesters of seminar (elected from BCH 531, 532, 533, and 534); and one additional course elected from BCH 601, 602, 611, 612. Six credits of course work must also be taken from a selection provided by the department. These courses are selected to encourage the student to broaden his background and are not included for program credit. There is no language requirement.

SPECIAL FINANCIAL AID

Graduate teaching assistantships are reserved for advanced Ph.D. students. Research assistantships are available through research awards to individual faculty members.

BIOPHYSICS

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY

Professor N. P. Wood, *chairman*. Professor Fisher; Associate Professor Hartman.

SPECIALIZATIONS

Electron microscopy, mammalian cell culture and tumor viruses, structure and functions of nucleic acid and ribosomes.

MASTER OF SCIENCE

Admission requirements: GRE and major in science or engineering; two semesters each in organic and physical chemistry and physics; mathematics through differential equations.

Program requirements: thesis and courses in biophysics, chemistry, physics, biology.

DOCTOR OF PHILOSOPHY (Biological Sciences)

Admission requirements: same as for master's degree.

Program requirements: a qualifying examination in physical chemistry and two selected from chemistry, physics, or biology. A master's degree may be accepted for one of the proficiency examinations. Comprehensive examination will require

knowledge of the biophysics courses and one outside area.

Students in the Molecular Biology Option will take research courses in microbiology, biochemistry and biophysics.

BOTANY

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY

Professor Goos, *chairman*. Professors Albert, Caroselli, Hauke, Lepper, Palmatier, Smayda, Wood; Assistant Professors Halvorson, Hargraves, Harlin, Mottinger, Swift; Adjunct Professor Simmons.

SPECIALIZATIONS

Aquatic botany (marine and freshwater), genetics and cytogenetics, mycology, plant development, plant ecology, plant pathology, plant physiology, plant taxonomy.

MASTER OF SCIENCE

Admission requirements: GRE including advanced test and undergraduate major in the sciences. Candidates lacking undergraduate courses in organic chemistry, physics, mathematics through introductory calculus, and fundamental courses in biological sciences may be required to make up deficiencies without graduate credit.

Program requirements: thesis and BOT 581, 582.

DOCTOR OF PHILOSOPHY (Biological Sciences)

Admission requirements: master's degree normally required; outstanding candidates may be accepted without a M.S. degree.

Program requirements: one foreign language or proficiency in a research tool.

BUSINESS ADMINISTRATION

M.B.A.

GRADUATE FACULTY

Professor Weeks, *dean*, College of Business Administration; Associate Professor Johnson, *assistant dean and director of M.B.A. program*.

Accounting: Assistant Professor Martin, *acting*

chairman. Professors G. W. Lees, Sanderson; Associate Professors Vangermeersch, Wood; Assistant Professors Brandon, duBois, Looney, Matoney.

Business Law: Professor Geffner; Associate Professor Peck.

Finance and Insurance: Professor Poulsen, *chairman.* Professors Brainard, Pitterman; Assistant Professors Booth, Fitzgerald, Hershberger, Speicher.

Management Science: Professor Vollmann, *chairman.* Associate Professors Jarrett, Shen, Sternbach; Assistant Professors Ageloff, Armstrong, Budnick, Mojena, Parsons, Sanghvi, Zartler.

Marketing Management: Professor Alton, *chairman.* Associate Professors Bowman, Hill, Nason; Assistant Professors Della Bitta, Loudon.

Organizational Management and Industrial Relations: Professor Coates, *chairman.* Professor Kaiser; Associate Professors deLodzia, Hoban, Schmidt; Assistant Professors Allen, Desfosses, Overton, Raffaele.

The Master of Business Administration program is offered on the Kingston campus for full-time and part-time students and in the evening at the Division of University Extension in Providence for part-time students. Full-time work is preferred and encouraged. Candidates may begin the program in June, September or February of each year. Applications to the Dean of the Graduate School should specify the M.B.A. program and indicate on which campus study is to be undertaken.

SPECIALIZATIONS

Accounting, finance, insurance, management science, marketing management, organizational management and industrial relations.

MASTER OF BUSINESS ADMINISTRATION

Admission requirements: undergraduate grade point average of B-minus or above (2.7 on a scale of 4.0) and a score at the 50th percentile or above (approximately 475) on the ATGSB examination. Applicants for whom English is not the native language will be expected to present a TOEFL score of at least 575, or they may be required to correct deficiencies by taking selected courses for no program credit.

Program requirements: the non-thesis program (36 credit hours) can be completed in one calendar year by students who satisfy all foundation requirements. Students with no foundation work

completed will take two calendar years (60 credit hours) to finish the program. ACC 611; ECN 690; FIN 641, 645; GBA 671, 681; MGS 682; MMG 651; OMR 626; MGS 681 or OMR 627; plus six credit hours of 500- or 600-level courses in the College of Business Administration or outside of the College of Business Administration, provided the student obtains prior permission from the M.B.A. director.

All 500- and 600-level courses offered by departments in the College of Business Administration are open to matriculated graduate students only.

BUSINESS EDUCATION

M.S.

GRADUATE FACULTY

Assistant Professor Langford, *chairman.* Associate Professor Smith; Assistant Professor Sink.

SPECIALIZATIONS

Administration and supervision of business education, use of audiovisual equipment and materials in business education, consumer education, innovations in teaching business education, survey of office and distributive occupations, cooperative education programs, business communications.

MASTER OF SCIENCE

Admission requirements: undergraduate grade point average of 2.5 or above (scale of 4.0) and a 40th percentile ranking or above on the MAT examination for conditional admission; undergraduate grade point average of 2.7 or above and a 50th percentile ranking or above on the MAT examination for full admission.

Program requirements: undergraduate credit hours in accounting, finance, economics, marketing, management, production, statistics and business law. Candidates lacking undergraduate courses in business education may be required to make up deficiencies. Thirty credit hours without a thesis, including BED 524, 525, 526; six credits selected from BED 520, 522, 528; three credits in economics numbered above 400; three credits selected from EDC 572 and BED 428; six credits in academic business subjects selected from accounting, business law, computer science, economics, finance, insurance, management science and marketing management courses; plus three credits

of graduate-level free electives numbered above 500.

All 500- and 600-level courses offered by departments in the College of Business Administration are open to matriculated graduate students only.

CHEMICAL ENGINEERING

M.S., Ph.D.

GRADUATE FACULTY

Professor Treybal, *chairman*. Professors Gielisse, Madsen, Mairs, Mohrnhelm, Shilling, Thompson; Associate Professors Rockett, Rose, Votta; Assistant Professors Barnett, Knickle; Adjunct Associate Professors Dimeglio, Doyle; Adjunct Assistant Professors Sahagian, Soltz, Spano.

SPECIALIZATIONS

Adsorption, biochemical engineering, biomedical engineering, boiling heat transfer, catalysis, ceramics, corrosion, desalination, dispersion processes, distillation, fluid dynamics, heat transfer, ion exchange, kinetics, mass transfer, materials engineering, membrane processes, metal finishing, metal oxidation, metallurgy, nuclear technology, phase equilibria, pollution control, polymers, process dynamics, thermodynamics, water resources, X-ray metallography.

MASTER OF SCIENCE

Admission requirements: GRE and undergraduate major in engineering, biology, chemistry, or physics.

Program requirements: thesis (no qualifying examination) or non-thesis option (qualifying examination, comprehensive report and oral examination); CHE 501, 502.

DOCTOR OF PHILOSOPHY

Admission requirements: GRE and M.S. degree in engineering (may be waived for University of Rhode Island graduate students who pass qualifying examination with superior performance).

Program requirements: a candidate's program will be determined in consultation with his committee and be based on his background and career goals. There is no general language requirement but a student's committee may require a foreign language or research tool which may be

necessary for the student's program. In addition to an acceptable dissertation, a candidate must submit the manuscript of a paper, based on his research, suitable for transmittal to a technical journal; CHE 501, 502.

CHEMISTRY

M.S., Ph.D.

GRADUATE FACULTY

Professor Goodman, *chairman*. Professors Abell, Kraus, MacKenzie, Rosie, Vittimberga; Associate Professors Brown, Gonzalez, Nelson, Petersen; Assistant Professors Cheer, Fasching, Hamlet, Kirschenbaum, Rosen.

SPECIALIZATIONS

Theoretical aspects include quantum mechanics, molecular orbital calculations, spectral interpretations, reaction mechanisms and kinetics (organic and inorganic), computer simulation, and hyper-reactive intermediates. Analytical and structural studies employ spectral methods, mass spectrometry, light scattering, surface chemistry, photochemistry, organometallic compounds, X-ray crystallography, electrochemistry, neutron activation analysis, and gas chromatography. Applications to contemporary problems include studies in ancient organic residues, drug-receptor interactions, nucleosides, chelatable polymers, heterocycles, air and ocean analyses, alkali metal superoxides, and liquid crystals.

MASTER OF SCIENCE

Admission requirements: GRE, including advanced test. Minimum TOEFL score of 560. Preference is given to candidates with undergraduate majors in chemistry or chemical engineering with mathematics through calculus.

Program requirements: for thesis option (30 credit hours), requires 12 credit hours of graduate core courses, CHM 641 or 642 and thesis; for non-thesis option (36 credit hours), requires 18 credit hours of graduate core courses, CHM 641 or 642 and CHM 551, 552.

DOCTOR OF PHILOSOPHY

Admission requirements: same as for master's degree.

Program requirements: 18 credit hours of graduate core courses, CHM 641, 642; language, read-

ing proficiency in one foreign language (French, German or Russian) or a research tool (computer science).

CHILD DEVELOPMENT AND FAMILY RELATIONS

M.S.

GRADUATE FACULTY

Associate Professor Cohen, *chairman*. Professors Fitzelle, R. C. Smart; Associate Professors Greene, Spence; Assistant Professor Cooper; Adjunct Professor M. S. Smart.

SPECIALIZATIONS

Social and personality development in children, family life education, early childhood development.

MASTER OF SCIENCE

Admission requirements: fall admission; GRE and 18 undergraduate credit hours distributed among at least three of the following areas: child development and family relations, psychology, sociology, biology, education.

Program requirements: 24 course hours plus 6 credits toward thesis (30 credit hours) or 24 course hours plus 6 related action thesis credits (30 credit hours).

CIVIL AND ENVIRONMENTAL ENGINEERING

M.S., Ph.D.

GRADUATE FACULTY

Associate Professor McEwen, *chairman*. Professors Campbell, Nacci; Associate Professors Lavelle, Moulthrop, Poon; Assistant Professors Fang, Kelly, Marcus, Sussman, Wang.

SPECIALIZATIONS

Water supply and treatment facilities, municipal and industrial waste treatment, ground water seepage, flocculation and coagulation of wastes, phosphate and nitrate removal, air pollution, solid waste management, modeling of environmental systems, physio-chemical properties of ocean sediments, soil stabilization, thermal properties of

soils, adsorption on minerals and clays, sampling of ocean sediments, marine structures, optimum structural design, thin-walled structures, structural stability, experimental stress analysis, flexible and rigid pavement design, curved highway bridges.

MASTER OF SCIENCE

Admission requirements: GRE and bachelor's degree in civil or environmental engineering. Candidates in other engineering fields or in mathematics, biology, chemistry or physics may be accepted with the possible addition of prerequisite courses.

Program requirements: thesis or non-thesis option. 30 credit hours plus CVE 601, 602; a minimum of two courses taken outside the department.

DOCTOR OF PHILOSOPHY

Admission requirements: GRE and master's degree in civil or environmental engineering or in a related field.

Program requirements: 30 course credits beyond the master's degree; one language; a three course and a two course minor from outside the department which may include work at the master's level.

COMMUNITY PLANNING AND AREA DEVELOPMENT

M.C.P.

GRADUATE FACULTY

Associate Professor Feast, *director*. Professor Jeffrey; Associate Professors Downe, Foster, Hammerschlag, Kumekawa; Assistant Professors Barber, Brooks, Mahayni; Instructor Johnson; Adjunct Professor Thomas.

SPECIALIZATIONS

Planning administration; urban design; advocacy planning; planning methods and techniques; land use planning; regional and area planning; urban renewal; comprehensive social, economic and physical community programming; regional analysis and development planning.

MASTER OF COMMUNITY PLANNING

Admission requirements: GRE; undergraduate background in the social sciences, architecture, landscape architecture, engineering or geography

preferred. Students are normally not admitted for February matriculation and part-time students are admitted only under very unusual circumstances.

Program requirements: CPL 511, 603, 604, 613, 614, 623, 634, 642; thesis; summer internship or equivalent professional experience. The two-year program of 60 credit hours is distributed as follows: Seminar in Contemporary U.S. Environment, 16 credits; Planning Application Studios, 14 credits; Introductory Methodology, 6 credits; electives and thesis, 24 credits. Students normally take 15 credits per semester.

SPECIAL FINANCIAL AID

U.S. Department of Housing and Urban Development, ASPO/FORD, and Fleischman Foundation fellowships for members of minority groups.

COMPUTER SCIENCE

M.S.

GRADUATE FACULTY

Professor Hemmerle, *chairman*. Professors Merenda, Smith; Associate Professors Carney, Lawing; Assistant Professors Bass, Carrano, Hanumara, Tetreault, Weideman.

SPECIALIZATIONS

Operating systems, statistical computations, simulation, numerical analysis, artificial intelligence, programming languages, information retrieval, performance evaluation, theory of computation, computer-aided education, computer organization.

MASTER OF SCIENCE

Admission requirements: bachelor's degree with a minimum of 18 credit hours in mathematics, statistics, or computer science including the equivalent of MTH 141, 142 Introductory and Intermediate Calculus with Analytic Geometry; MTH 243 Calculus and Analytic Geometry of Several Variables; MTH 215 Introduction to Algebraic Structures; and CSC 410 Introduction to Computer Science and Algorithmic Processes. GRE-V, GRE-Q and GRE-advanced test in mathematics or undergraduate major field are required for admission.

Program requirements: CSC 411 and either 412 or 413 are required of all M.S. candidates. Every student is also expected to complete at

least 12 credits at the 500 level. Nine of these credits must be in computer science, in courses other than CSC 591, 592. The student will select at least six additional credit hours in supporting courses. A thesis is required.

ECONOMICS

M.A.

GRADUATE FACULTY

Professor Sabatino, *chairman*. Professors Dirlam, Haller, Hellman, Norton, Rayack, Schurman; Assistant Professors Starkey, Suzawa, Ramsay; Instructors Barnett, Hume.

SPECIALIZATIONS

Economic development, economic theory, industrial organization, international economics, money and banking, public finance, econometrics, mathematical economics.

MASTER OF ARTS

Admission requirements: GRE scores for verbal and quantitative tests and, normally, some undergraduate training in economics. Some training in mathematics and statistics is also desirable.

Program requirements: thesis or non-thesis option, 30 credit hours, including, for Track I, ECN 512, 527, 528, 575, 576, and 515 or 516 or thesis. This track is strongly advised for students desiring to pursue further studies in the mainstream of contemporary thought or to prepare themselves for professional work in business, government and teaching at the university level. For Track II, ECN 512 527, 528 and 515 or 516 or thesis. This track is available to students who prefer a wider range of courses and more freedom of choice.

ECONOMICS (Interdepartmental)

Ph.D. Economics, Marine Resource Option

This interdepartmental program offers study in the economics of marine resources. It is administered by a graduate economics faculty from several disciplines.

GRADUATE FACULTY

Professor Sabatino, *chairman*. Professor Cummings, *vice chairman*.

Economics: Professors Haller, Hellman, Rayack, Sabatino, Schurman; Assistant Professors Ramsay, Starkey, Suzawa.

Economics and Resource Economics: Professors Dirlam, Norton.

Economic Development and Regional Planning: Professor Jeffrey.

Finance: Professors Pitterman, Poulsen.

Resource Economics: Professors Cummings, Lampe, Holmsen, Rorholm; Assistant Professors Gates, Grigalunas, McConnell, McFarland, Seay, Weaver.

DOCTOR OF PHILOSOPHY

Admission requirements: GRE preferably including advanced test in economics or MAT and bachelor's degree with strong background in statistics or mathematics.

Program requirements: ECN 512, 527, 528, 576, 627, 628; EST 520; and at least 15 credits from the following: REN 534, 543, 602, 634, 635; ECN 532, 543; EST 541. Additional courses may be selected from ECN 438, 464, 515, 543, 552, 566, 595; REN 442, 577, 610, 675; FIN 410, 440; CSC 500; EST 532; or from appropriate offerings in industrial engineering, geography, oceanography, mathematics and political science.

The dissertation will be written on a special problem concerning marine resources or an associated industry, such as minerals, petroleum, fisheries, water utilization, transportation, recreation, and waste disposal.

EDUCATION

M.A.

GRADUATE FACULTY

Professor MacMillan, *chairman*. Associate Professor Purnell, *coordinator of graduate studies*.

Audiovisual: Assistant Professor Cresser.

Educational Research: Associate Professors Purnell, Soderberg; Assistant Professors Allen, Long, Pezzulla, Schaffran, Sullivan.

Elementary Education: Professor Nally; Associate Professor W. P. Kelly; Assistant Professors Nagel, Sullivan, Whitcomb.

Guidance: Professors Quinn, Rife; Associate Professor Pascale; Assistant Professors Gunning, Maynard.

Reading: Professor Aukerman; Associate Professor McGuire; Assistant Professor Bumpus.

Science Education: Associate Professor Croasdale; Assistant Professor Kellogg.

Secondary Education: Professors Casey, Russo; Associate Professor Heisler; Assistant Professors Allen, Calabro, Hagey, Howard, Long, Nelson, Willis.

Youth and Adult Education: Associate Professor Bromley; Assistant Professor McCreight.

Enrollment of foreign students is limited; a minimum TOEFL score of 600 is required.

The Master of Arts degree is offered in the following areas of study. Applicants should specify the area of specialization on the application form.

EDUCATIONAL RESEARCH

Admission requirements: MAT or GRE, teaching certificate, strong background in mathematics or statistics.

Program requirements: thesis preferred; EDC 503, 514 or 574, 529, 570 or 571; PSY 410, 434, 510, 520; computer science elective.

ELEMENTARY EDUCATION

Admission requirements: MAT and teaching certificate, one year teaching experience desirable.

Program requirements: thesis or non-thesis option. EDC 503, 529; 18-24 hours of education electives including six hours for thesis or non-thesis seminar and six credit hours taken outside education offerings.

GUIDANCE

Admission requirements: MAT, teaching experience at elementary or secondary school desirable for counseling at these levels, personal interview. Applications for summer, fall, and spring admissions reviewed by January 15, April 15, and October 15, respectively.

Program requirements: thesis or non-thesis option. EDC 450, 529, 550, 551, 552, 553, 554, 555, 556; PSY 434. Six additional hours as planned with adviser.

READING

Admission requirements: MAT and teaching certificate, teaching experience under contract.

Program requirements: thesis or non-thesis option. EDC 503, 529; 24 credit hours of courses approved for the preparation of reading specialists including six credit hours of clinic or practicum experience, and one or more electives.

SCIENCE EDUCATION

Admission requirements: MAT and teaching certificate, undergraduate major in science, interview with faculty.

Program requirements: EDC 529; 12-18 credit hours of education electives including six hours of thesis or non-thesis seminar and a minimum of 12 hours of science courses.

SECONDARY EDUCATION

Admission requirements: MAT and teaching certificate, one-year teaching experience desirable, undergraduate major in academic area of secondary education, interview with appropriate faculty.

Program requirements: thesis or non-thesis option. EDC 503, 529; 571, 572, or 574; additional 9-15 credit hours of education courses including six hours for thesis or non-thesis seminar and a minimum of 12 credit hours in academic area presented at admission.

YOUTH AND ADULT EDUCATION

Admission requirements: MAT, teaching certificate or sound background in general education and/or social sciences, interview with program faculty.

Program requirements: thesis or non-thesis option. EDC 505, 529; 580, or 581; 582, 583, or 584; 585; and a minimum of 18 credit hours of education or other electives including six hours of thesis or non-thesis seminar. All courses are offered in late afternoon and/or evening.

ELECTRICAL ENGINEERING

M.S., Ph.D.

GRADUATE FACULTY

Professor Polk, *chairman*. Professors Lengyel, Lindgren, Mitra, Tufts; Associate Professors Etzold, Haas, Jaron, Mardix, Poularikas, Sadasiv, Spence; Assistant Professors Birk, Daly, Kelley; Adjunct Professors Biberman, Hall, Kazan, Middleton, Zirkind.

SPECIALIZATIONS

Control of non-linear, time-varying and distributed parameter systems; stability theory; dynamics of biological systems; biological effects of electromagnetic radiation; visual tracking; study of neuron-

like networks; computer systems design and computer graphics; information systems design; communication systems; data compression; electromagnetic wave propagation; geophysical electrodynamics (geomagnetism, atmospheric electricity, ionospheric physics); plasma dynamics; quantum electronics; solid-state electronics; optical properties of materials; electro-optical systems; photo-electronic imaging devices (design and analysis); microelectronics; architectural and electro-acoustics; underwater acoustics; ocean electronic systems; remote sensing.

MASTER OF SCIENCE

Admission requirements: GRE and B.S. in electrical engineering, engineering science, physics, mathematics, or computer science. Preparation in related fields such as aeronautical, civil, chemical and mechanical engineering or in the life sciences may be acceptable.

Program requirements: thesis or non-thesis option. For the thesis option, ELE 501, 511 and at least two courses selected from ELE 505, 509, 531, 561, 605 or equivalent.

DOCTOR OF PHILOSOPHY

Admission requirements: GRE and M.S. degree or equivalent in electrical engineering, engineering science, physics, mathematics or computer science.

Program requirements: for the comprehensive examination, background in several of the following areas is required—linear and non-linear systems, communication and control systems, design of digital systems, electromagnetic theory and solid state physics. Most students find it essential to become thoroughly familiar with the application of digital computer techniques. Dissertation research makes use of major, modern laboratories in the listed areas of specialization.

ENGLISH

M.A., Ph.D.

GRADUATE FACULTY

Professor Miller, *chairman*; Professor MacLaine, *director of graduate studies*. Professors Gullason, Hoffmann, Neuse, Petrie, Robinson, Smith, Sorlien; Associate Professors Barker, Mathews, Seigel, Sharpe, Steeves, Tutt; Assistant Professors Cane, Collins, Dvorak, Hills, Jacobs, Joel, Kunz, Malina, McCabe, Murphy, Reaves, Schoonover, Towers; Instructors Mensel, Titus.

SPECIALIZATIONS

For the M.A., American literature, English literature, comparative literature, literary criticism; *for the Ph.D.*, library sources are best suited for dissertation work in late Medieval and Renaissance English literature (including drama to 1642), English literature of the nineteenth century, American literature before 1900, English and American literature since 1900.

MASTER OF ARTS

Admission requirements: GRE and a minimum of 21 credits in English with a B-plus average in all English courses.

Program requirements: thesis; or for non-thesis option, two 600-level seminars and comprehensive examination in three fields.

DOCTOR OF PHILOSOPHY

Admission requirements: GRE with advanced test and M.A. in English or equivalent. Early application is desired due to limited enrollment.

Program requirements: reading knowledge of one foreign language is required, unless such requirement is waived by the program committee in consultation with the director of graduate studies.

ENVIRONMENTAL BIOLOGY

The Institute of Environmental Biology is an administrative organization consisting of faculty members active in graduate training and research in botany, electrical engineering, forestry, oceanography, pharmacology, and zoology, and of adjunct faculty members in associated federal and private laboratories, who provide an interdisciplinary approach to problems in environmental biology. Programs are designed to produce environmental biologists trained in depth in one academic discipline, but equipped to cross the usual boundaries between disciplines and cope with the larger problems of man and his environment.

Qualified students may become candidates for advanced degrees in the Departments of Civil, Electrical, and Mechanical Engineering; Botany; Food and Nutritional Science; Pharmacology; and Zoology; and in the Graduate School of Oceanography. Students must meet all requirements of their respective departments and colleges, and of the Graduate School, but it is expected that their programs of study will be interdisciplinary in nature and be supervised by an interdepartmental faculty committee. Degree re-

quirements are listed under the degree-granting departments.

Information is available from chairmen of the degree-granting departments or from Professor William L. Halvorson, Ph.D., director, Institute of Environmental Biology, c/o Department of Botany.

ENVIRONMENTAL HEALTH SCIENCES

An interdisciplinary program leading to a master of science degree in Environmental Health Sciences provides graduate training for persons interested in careers in laboratories of state departments of health or in those of federal agencies. Graduates of programs in several areas of biological, physical and health sciences, or in engineering who have developed an interest in public health should, in most cases, have the necessary prerequisites. The student's course of study is planned by an interdepartmental faculty committee and includes work in air pollution, sanitation, food microbiology and chemistry, and public health law and administration. Applicants must submit GRE scores. Information is available from the director of the program, Professor Leonard R. Worthen, Department of Pharmacognosy.

EXPERIMENTAL STATISTICS

M.S.

GRADUATE FACULTY

Professor Hemmerle, *chairman*. Professors Merenda, Smith; Associate Professors Carney, Lawing; Assistant Professors Bass, Carrano, Hanumara, Tetreault, Weiderman.

SPECIALIZATIONS

Experimental design, multivariate methods, statistical computations, sequential methods, non-parametric methods, sampling methods, industrial statistics, genetics, psychometrics.

MASTER OF SCIENCE

Admission requirements: bachelor's degree with credits in mathematics, statistics, or computer science, including the equivalent of MTH 141, 142, Introductory and Intermediate Calculus with Analytic Geometry; MTH 243, Calculus and

Analytic Geometry of Several Variables; MTH 215, Introduction to Algebraic Structures; CSC 201, Introduction to Computing; MTH 451, Introduction to Probability and Statistics or EST 409, Statistical Methods in Research I. GRE-V, GRE-Q, and GRE-advanced test in mathematics are required for admission.

Program requirements: six credits from MTH 451, EST 409 and 412. The candidate must complete MTH 451, EST 409, and EST 412; however, a maximum of six hours in these courses may be applied as program credit. Every student is also expected to complete at least twelve credits at the 500 level or above and nine of these credits must be earned in courses in experimental statistics, exclusive of EST 591, 592. The student will select, with the approval of his program committee, at least six additional credit hours in elective courses. A thesis is required.

FOOD AND NUTRITIONAL SCIENCE

M.S.

GRADUATE FACULTY

Professor Dymsha, *chairman*. Associate Professor Constantinides; Assistant Professors Bergan, Caldwell; Adjunct Professor Silverman.

The department offers a wide variety of individualized programs in close association with other departments such as Animal Science, Biochemistry, Child Development and Family Relations, Fisheries and Marine Technology, Food and Resource Chemistry, Home Economics Education, Microbiology, and Pharmacology and Toxicology. These graduate programs are enriched by departmental participation in the Sea Grant Program, the AID-supported International Center for Marine Resource Development, the Institute of Environmental Biology, the interdepartmental program in food science, the University gerontology program, and community and state nutrition programs. Work beyond the M.S. degree may be developed with other departments offering the Ph.D. degree in biological sciences.

SPECIALIZATIONS

Marine food preservation, food enzymology, utilization of fish and marine species, food safety, human nutrition and dietetics, nutritional status evaluation, nutritional biochemistry and metab-

olism, marine and new food sources, nutrition of fish and marine food organisms, nutrition education, international and domestic public nutrition improvement programs.

MASTER OF SCIENCE

Admission requirements: GRE and a bachelor's degree with adequate preparation for the proposed area of study.

Program requirements: thesis, FNS 504 and graduate courses approved by department.

FOOD AND RESOURCE CHEMISTRY

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY

Professor Felbeck, *chairman*. Professors Chichester, Olney, Salomon, Simpson; Associate Professor Rand; Assistant Professors Bergan, Lee; Adjunct Associate Professor Zarogian.

There is a close relationship in graduate study with the Departments of Biochemistry, Biophysics, Chemistry, Food and Nutritional Science, Animal Science, and Plant and Soil Science, and the Graduate School of Oceanography.

SPECIALIZATIONS

Food biochemistry, soil biochemistry, pesticide chemistry, soil chemistry, plant biochemistry, chemistry of agricultural and marine products.

MASTER OF SCIENCE

Admission requirements: GRE and a bachelor's degree in agricultural science, a biological science, or chemistry, at least one year of organic chemistry.

Program requirements: thesis and advanced courses in biochemistry and chemistry.

DOCTOR OF PHILOSOPHY (Biological Sciences)

Admission requirements: same as for master's degree, and M.S. degree with thesis requirement.

Program requirements: dissertation and advanced courses in biochemistry and chemistry.

FRENCH

M.A.

GRADUATE FACULTY

Associate Professor Kossoff, *chairman*, Department of Languages. Professors Porter, Waters; Associate Professors Hyland, Rothschild; Assistant Professors Benson, Chartier, Morello, Toloudis.

SPECIALIZATIONS

French literature, linguistics.

MASTER OF ARTS

Admission requirements: GRE or MAT and 24 semester hours, or equivalent, of French.

Program requirements: thesis, eight 500-level courses and comprehensive examination; or for non-thesis program, ten 500-level courses and comprehensive examination.

GEOGRAPHY

M.A.

GRADUATE FACULTY

Professor Alexander, *chairman*. Professors Higbee, Michel; Associate Professor Havens; Assistant Professor Capelle; Instructor Krausse.

SPECIALIZATIONS

Marine geography, political and economic geography, comparative urban processes and land utilization, meteorology and climatology, North America and the North Atlantic region, quantitative and cartographic methods.

MASTER OF ARTS

Admission requirements: GRE. The advanced examination in geography is not required, but candidates should have, or be prepared to make up without graduate credit, the equivalent of 12 credits of introductory work in physical geography (or earth science), cultural, economic, and political geography. Another 15 credits in related social or natural sciences are desirable, as are introductory courses in cartography and computer science.

Program requirements: thesis and, normally, GEG 421, 502, 591 or 592.

An interdisciplinary program involving 18 additional credits in geography, history, and political science leads to a Graduate Certificate in North Atlantic Regional Studies awarded by the Dean of the Graduate School as an adjunct to the M.A. in geography.

GEOLOGY

M.S.

GRADUATE FACULTY

Professor Cain, *chairman*. Associate Professors Hermes, Tynan; Assistant Professors Fisher, Frohlich, Hampton.

SPECIALIZATIONS

Coastal geology (geomorphology, sedimentology); igneous and metamorphic petrology-geochemistry; palynology. Individual programs may include courses and/or research in conjunction with the Graduate School of Oceanography. Interdisciplinary studies are encouraged.

MASTER OF SCIENCE

Admission requirements: GRE and bachelor's degree in science or engineering. By the end of the first year, students lacking an undergraduate major in geology will be required to demonstrate, through course work and/or a qualifying examination, satisfactory knowledge of geology and related fields.

Program requirements: thesis, written comprehensive examination in addition to defense of thesis.

HISTORY

M.A.

GRADUATE FACULTY

Professor Findlay, *chairman*. Professors Klein, Metz, Thomas, Weisbord; Associate Professors Briggs, Cohen, Gutchen, Kim; Assistant Professors Brown, Bryan, Costigliola, Daniel, Honhart, Roughton, Silvestri, Strom, Thurston.

SPECIALIZATIONS

American history; diplomatic history; East Asian, African, Black, Latin American and women's

history; imperialism; history of science; modern English history; modern European history; state and local history.

MASTER OF ARTS

Admission requirements: GRE (advanced test desirable) and bachelor's degree with at least 24 credits in history. Majors in related fields may be admitted with permission of the department.

Program requirements: thesis option (30 credit hours) to include four courses at 500 level, at least one of which must be a colloquium and one must be a seminar; non-thesis option (30 credit hours) to include five courses at the 500 level, at least one of which must be a colloquium and two must be seminars. Both options require a four-hour written examination and an oral examination. Two courses in a related field are recommended.

HOME ECONOMICS EDUCATION M.S.

GRADUATE FACULTY

Associate Professor P. S. Kelly, *director*. Professor Cusack; Associate Professors May, MacKenzie; Assistant Professor Cooper.

The M.S. in Home Economics Education is interdepartmental within the College of Home Economics. The graduate student's program is planned on an individual basis considering the student's needs and interests, past educational and professional experiences, and future goals. Home Economics Education will be emphasized with additional courses chosen from one of the following home economics subject matter areas: (1) management and consumer education, foods and nutritional science, textiles and clothing, and/or child development and family relations; or (2) selection of one or two courses from each of the areas listed above; plus (3) additional courses selected from related areas such as education, psychology, sociology, economics, business.

The Home Economics Education program also offers courses to meet the Rhode Island certification requirements for a permanent teaching certificate. Thirty-six credits or an M.S. are required within six years of receiving one's Provisional Secondary Certificate in Home Economics.

SPECIALIZATIONS

Curriculum development, leadership development

for supervision and administration of home economics programs, interaction analysis, innovative practices in methods and teaching techniques.

MASTER OF SCIENCE

Admission requirements: B.S. or B.A. in home economics with certification for teaching; experience or interest in teaching home economics; GRE and GRE Advanced Test in Education.

Program requirements: for thesis option (30 credits), thesis, research methods course, basic knowledge of statistics, four-hour written comprehensive examination, two-hour oral defense of thesis; for non-thesis option (36 credits), action research project, research methods course, four-hour written comprehensive examination, oral presentation of action research project.

INDUSTRIAL ENGINEERING M.S.

GRADUATE FACULTY

Professor James, *chairman*. Professor Nichols; Associate Professors Black, Lawing, Rubinsky; Assistant Professors Branson, Shao.

SPECIALIZATIONS

Applied operations research, materials manufacturing and processes, production systems, production and inventory control, applied engineering statistics and probability, stochastic processes, human factors, occupational safety and health engineering, quality control and reliability, health systems.

MASTER OF SCIENCE

Admission Requirements: GRE, aptitude test (verbal and quantitative) and advanced test in engineering. A B.S. degree in industrial engineering is preferable but applications are encouraged from persons holding the B.S. from an accredited program in any recognized field of engineering. An applicant with a B.S. in physics, chemistry, or mathematics will also be considered.

Program requirements: thesis and non-thesis options are available, one course each in operations research and computer science, two courses in probability-statistics.

SPECIAL FINANCIAL AID

Research assistantships in various areas plus part-time professional employment in local industries and hospitals.

INTERNATIONAL STUDIES

International studies are represented by international orientations in many graduate programs as well as by the specialized programs described below. The International Studies Committee is charged with the overall task of developing policy, coordinating programs, and monitoring the University's work in this area. It includes representatives of the Graduate School, the Graduate Student Association, the International Student Affairs Office, the Graduate School of Oceanography, the College of Business Administration, the College of Engineering, the College of Resource Development, the Law of the Sea Institute, the Master of Marine Affairs Program, and the Departments of Economics, Education, Geography, History, Languages, and Political Science in the College of Arts and Sciences.

Inquiries concerning international orientations available through various combinations of electives within existing degree programs may be addressed to the department in which the student plans to enroll or to Peter J. Gielisse, Ph.D., *chairman*, International Studies Committee, c/o the Graduate School. Further information may also be obtained from Russell C. Smart, Ph.D., *adviser for International Studies*, or Theodore Suddard, *director for International Student Affairs*.

SPECIALIZATIONS

Master of Arts in Political Science with International Relations Specialization. The Department of Political Science offers over 20 courses in international relations and area studies enabling students to fashion programs suitable to their special interests. To insure an interdisciplinary approach, the department encourages students to take up to 12 credits of relevant course offerings in economics, history, geography, or sociology. For requirements, see Political Science.

Graduate Certificate Program in International Development Studies. A five-course, 15-credit program leading to a Graduate Certificate awarded by the Dean of the Graduate School is offered in each spring semester by the Departments of Economics, Geography, Political Science, and Resource Economics. The Department of Sociology and Anthropology also participates in cer-

tain aspects of this new program. Sponsored by the University's International Studies Committee and supported by the University's International Center for Marine Resource Development, this graduate certificate program is designed to provide a supplemental, interdisciplinary concentration on the problems and processes of modernization and international development. The program is open to holders of the master's degree (or its equivalent) in one of the participating disciplines as well as to candidates for such a degree at the University of Rhode Island.

The program is functional in design. It is built around a core interdisciplinary seminar, two more specialized seminars or courses in political science and economics, and a directed studies course in which the student engages in individualized research under the guidance of an indepartmental panel. This research course allows each student to pursue a topic of particular interest to him. In addition, the student chooses an elective course from a list of which at least four of five choices should be available in any semester. Thus, it is possible to complete the entire program in a single spring semester, a factor of importance to those on leave from other institutions or governmental and international agencies.

Requests for further information and for application forms should be directed to the Dean of the Graduate School. Initial inquiries should indicate in which of the above disciplines, and from which institution, the applicant holds the master's degree, or whether he is interested in pursuing the master's degree at this University concurrently with the graduate certificate program, and where his particular research interests lie. Such information will assist the administering committee in selecting an adviser for the student and in designing a program adapted to his needs.

For interdepartmental Ph.D. degree program, see Economics, Marine Resource Option.

Graduate Certificate in North Atlantic Regional Studies. Designed to take advantage of the University's location in a northeastern state with a strong tradition of involvement in maritime and naval affairs, and with strong commercial and cultural ties with Western Europe, this program is an adjunct to the M.A. degree in geography or in political science. It is open both to University of Rhode Island degree candidates in these departments and to those who have already received an equivalent master's degree from other institutions. Successful completion results in the award of the Graduate Certificate by the Dean of the Graduate School.

The program requires two core courses plus four electives. The core courses are GEG 545

and a directed study or research course in geography or political science in which the student prepares and defends a substantial paper under the direction of a faculty committee. The four electives may be chosen from GEG 441, 443, 543, 571; HIS 411, 418; PSC 301, 431, 464, 472, 513. Assistantships or scholarships are not available for participants in the Graduate Certificate Program as such, but may be held by students who are concurrently enrolled in the M.A. programs in geography or political science.

Additional information is available from the chairman of the Department of Geography.

LIBRARY SCIENCE

M.L.S.

The Master of Library Science program is accredited by the American Library Association.

GRADUATE FACULTY

Professor Humeston, *dean*, Graduate Library School. Associate Professors Bergen, Chin; Assistant Professors Bohnert, Healey, Salvatore, Schneider, Tryon.

SPECIALIZATIONS

Readers' services, technical services, information science, bibliography and services in public school, college and university and special libraries.

MASTER OF LIBRARY SCIENCE

Admission requirements: MAT or GRE and the bachelor's degree. Applicants are admitted for June and September *only*. Because of the limitations on enrollments, all materials required for application should be received by the Graduate School by February 15 for June admission and by April 15 for September admission. For the same reason it may happen that some applicants meeting requirements will be denied admission because other applicants present stronger credentials. Notification of acceptance or rejection for June admission will normally be in late March and for September admission normally in late May.

Program requirements: 36 credit hours, 27 or more in library science; LSC 500, 502, 503, 504 and 505, and one course selected from LSC 520, 521, 522 or 523.

MARINE AFFAIRS

M.M.A.

GRADUATE FACULTY

Professors Alexander (geography), *director*; Knauss (oceanography), *provost for marine affairs*. Professors Marshall (oceanography), Rorholm (resource economics), Sheets (ocean engineering); Assistant Professors Fisher (geology), Gamble (marine affairs); Instructor Cameron (marine affairs).

This 30-credit program is for those persons interested in problems of evaluation, use and control of the marine environment. Normally the work is completed in nine months of intensive, full-time resident study with considerable independent responsibility on work projects and substantial written work. It is administered by a committee from the Departments of Resource Economics, Geography, Geology, Ocean Engineering, Political Science, and the Graduate School of Oceanography.

SPECIALIZATIONS

Regimes for the deep seas, decision inputs for coastal zone regulation, jurisdictional requirements for pollution controls, criteria for deciding among competing uses for the continental shelf, applications of cost-benefit analysis to systems models for coastal decisions, implications of treating ocean basins as distinct regions, regulation of the high seas fisheries, impact of ocean engineering advances on the definition of the continental shelf, and legal problems of international scientific expeditions.

MASTER OF MARINE AFFAIRS

Admission requirements: GRE, MAT (in special cases), ATGSB, or LSAT: prior graduate degree or equivalent experience in marine areas. Applicants are admitted for September *only*.

Program requirements: non-thesis program, REN 514, GEG 571, OCE 500, OCG 401 or appropriate oceanography substitute, PSC 464, MAF 651, 652.

SPECIAL FINANCIAL AID

Marine affairs fellowships up to \$4000 are available.

MATHEMATICS

M.S., Ph.D.

GRADUATE FACULTY

Associate Professor Ladas, *chairman*. Professors Haggerty, Lakshmikantham, Roxin, Suryanarayan; Associate Professors Datta, Driver, Fraleigh, Schwartzman, Sine, Verma; Assistant Professors Barron, Beauregard, Caldwell, Finizio, Grove, Lewis, Liu, Papadakis.

SPECIALIZATIONS

Ordinary, functional, and stochastic differential equations, integral equations, control theory and differential games, probability and statistics, approximation theory, fluid mechanics, continuum mechanics, electrodynamics, topological dynamics, differential geometry, algebraic topology, ring theory, functional analysis, partial differential equations.

MASTER OF SCIENCE

Admission requirements: GRE (advanced test desirable).

Program requirements: 30 credit hours (or 24 plus thesis) including at least 15 credits in mathematics at the 500 level or higher and at least 6 additional credits in mathematics at the 400 level or higher. Recommended courses include MTH 515, 516, 525, 535, 536, and 562.

DOCTOR OF PHILOSOPHY

Admission requirements: GRE (advanced test required).

Program requirements: MTH 515, 516, 525, 535, 536, and 562, plus specialized courses and electives. Two languages chosen from French, German, Russian; or one of these and computer science as a research tool.

MECHANICAL ENGINEERING AND APPLIED MECHANICS

M.S., Ph.D.

GRADUATE FACULTY

Professor Nash, *chairman*. Professors Bradbury, Brown, Conta, Dowdell, Ferrante, Schenck, Test, White; Associate Professors DeLuise, Goff, Hagist, Hatch, Kim, Parker, Velletri, Wilson; Assistant Professors Lessmann, Palm.

SPECIALIZATIONS

Hydrodynamics, gasdynamics, magnetofluid-mechanics, two-phase flow, turbulence, fluidics, flow instrumentation, heat transfer, thermodynamics, elasticity, plasticity, materials, vibration, fatigue failure and fracture mechanics, reliability of mechanical engineering systems, biomechanics, kinematics, dynamics, stability, systems analysis, controls, analog and digital computer simulation, thermal pollution, thermal stress analysis.

MASTER OF SCIENCE

Admission requirements: GRE with advanced test; B.S. degree in mechanical engineering, applied mechanics, or aerospace engineering or in a related field such as engineering science, civil engineering, applied physics, applied mathematics.

Program requirements: thesis, two advanced-level courses in mathematics (or one in mathematics and one in computer science), one course outside area of specialization.

DOCTOR OF PHILOSOPHY

Admission requirements: master's degree and GRE with advanced test.

Program requirements: two advanced-level courses beyond M.S. in mathematics or computer science, one course outside area of specialization; research tool or associated studies in two areas.

MEDICINAL CHEMISTRY

M.S., Ph.D. (Pharmaceutical Sciences)

GRADUATE FACULTY

Professor Bond, *chairman*. Associate Professors Abushanab, Smith, Turcotte; Adjunct Professor Modest; Adjunct Associate Professor Pringle.

SPECIALIZATIONS

Design and synthesis of potential medicinal agents, including antihypertensives, steroids, antimetabolites, antitumor agents, complex lipids, and molluscicides; development of methods of drugs analysis; drug instabilities.

MASTER OF SCIENCE

Admission requirements: GRE, including advanced test in chemistry, and bachelor's degree in pharmacy, chemistry, or allied sciences. TOEFL, minimum total score of 500, for foreign students.

Program requirements: thesis; physical chemistry and CHM 421, 425; MCH 443, 444, or equivalent; MCH 621, 622; one modern foreign language recommended.

DOCTOR OF PHILOSOPHY (Pharmaceutical Sciences)

Admission requirements: GRE, including advanced test in chemistry, and master's degree in pharmacy, chemistry, or allied sciences or bachelor's degree in one of these with evidence of superior ability. TOEFL, minimum total score of 500, for foreign students.

Program requirements: reading knowledge of scientific German; CHM 522, and 621; primary emphasis in organic and medicinal chemistry or pharmaceutical analysis, and secondary emphasis in related areas, e.g., physical chemistry, biochemistry, pharmacology, physical pharmacy, or pharmacognosy.

MICROBIOLOGY

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY

Professor N. P. Wood, *chairman*. Professors Carpenter, Houston, Sieburth, Traxler; Associate Professor Cohen; Assistant Professor Shivers; Adjunct Professor Cabelli; Adjunct Associate Professor Prager.

SPECIALIZATIONS

Pathogenic bacteriology, immunology, microbial genetics, general microbiology, industrial microbiology, food and sanitary microbiology, phycology, bacterial physiology and metabolism, marine bacteriology, molecular biology, microbial ecology.

MASTER OF SCIENCE

Admission requirements: GRE and elementary courses in zoology, botany, and microbiology; organic, inorganic and quantitative analytical chemistry; introduction to biochemistry; physics; mathematics; genetics.

Program requirements: BCH 581; MIC 401, 599, 695 and 696; remaining courses in microbiology including one from an area other than bacteriology (virology, mycology or phycology).

DOCTOR OF PHILOSOPHY (Biological Sciences)

Admission requirements: same as for master's degree and one year of modern foreign language, and calculus.

Program requirements: BCH 581, 582; BPH 521; CHM 431; MIC 401, 533, 541, 552, 621, 695, 699; two courses in microbiology from an area other than bacteriology (virology, mycology or phycology); statistics.

NUCLEAR ENGINEERING

M.S.

GRADUATE FACULTY

Associate Professor Rose, *program coordinator*. Professors Mairs, Madsen; Assistant Professor Knickle; Adjunct Associate Professor DiMeglio; Adjunct Assistant Professor Doyle.

The program in nuclear engineering is administered by the Department of Chemical Engineering.

SPECIALIZATIONS

Boiling heat transfer, desalination, dosimetry, fluid dynamics, heat transfer, ion exchange, mass transfer, metallurgy, nuclear technology, reactor design and evaluation, shielding, spectrometry.

MASTER OF SCIENCE

Admission requirements: GRE and a bachelor's degree in engineering, physics, or mathematics.

Program requirements: thesis and at least 12 credits in nuclear engineering with other subjects chosen from mathematics, physics, chemistry, and other branches of engineering.

SPECIAL FINANCIAL AID

A limited number of graduate and research assistantships are available.

NURSING

M.S.

GRADUATE FACULTY

Professor Tate, *dean*. Professor Cumings; Associate Professor Hirsch.

SPECIALIZATIONS

General nursing with teaching or administration.

MASTER OF SCIENCE

Admission requirements: MAT and a bachelor's degree from an NLN-accredited program with an upper division major in nursing.

Program requirements: 36 credit hours without thesis, including 21 credits in nursing which includes practicum, 3 credits in biological science, 6 credits in behavioral science, 6 elective credits related to functional area.

OCEAN ENGINEERING

M.S., Ph.D.

GRADUATE FACULTY

Professor Sheets, *chairman*. Professors Brown, Middleton, Nacci, Schenck, White; Associate Professors Haas, Kowalski, Rose; Assistant Professors LeBlanc, Moffett; Adjunct Assistant Professor DiNapoli.

SPECIALIZATIONS

Desalination of sea water, nuclear energy applications, corrosion, physical properties of marine sediments, acoustic properties of sediments, finite amplitude acoustics, in-situ sediment measurements, sediment transport, coring techniques, bottom profiling and penetration; coastal and underwater structures, estuarine pollution, pollution abatement, waste disposal, turbidity measurements, mathematical modeling of estuaries; underwater acoustics, applications of information theory to underwater communications and data acquisition, turbulent boundary layer flow noise, underwater construction, guidance and control of underwater vehicles, digital processing of wave, current, and thermistor data; dynamics of towed body shapes, design of undersea pressure vessels, inelastic behavior of buoyant materials, wave motion and current studies, drag reduction with polymer additives, buoy dynamics, scuba safety and work effectiveness, underwater tooling, hydrodynamics of floating and submerged bodies.

MASTER OF SCIENCE

Admission requirements: GRE and B.S. degree in any classical engineering field, mathematics, physics or geology.

Program requirements: thesis and three courses selected from OCE 512, 561, 571, 587, 610, 521 or 534, 565 or 591; one course selected from OCG 501, 521, 540, 561; and at least 12 course credits of electives.

DOCTOR OF PHILOSOPHY

Admission requirements: GRE and M.S. degree and master's thesis in engineering, physics or equivalent; ocean engineering and oceanography core courses, as in master of science program. Requirements must have been taken previously or will have to be made up for no program credit.

Program requirements: dissertation; one advanced applied mathematics course; completion of 30 course credits beyond master's.

SPECIAL FINANCIAL AID

Link Foundation fellowship for M.S. candidate; a limited number of graduate and research assistantships are available for highly qualified students.

OCEANOGRAPHY

M.S., Ph.D.

GRADUATE FACULTY

Professor Knauss, *provost for marine affairs*, and *dean*, Graduate School of Oceanography; Associate Professor Napora, *assistant dean for students*. Professors Dietz, Duce, Jeffries, Marshall, McMaster, Pratt, Saila, Sieburth, Smayda, Stern, Watkins, Winn; Associate Professors Kennett, Kester, Pilson, Quinn, Sastry, Schilling; Assistant Professors Bender, Hargraves, Lambert, Nixon, Swift; Adjunct Professors deBoer, Eisler, Holt, Kenyon, Krause, Phelps, Sturges; Lecturer Oviatt.

SPECIALIZATIONS

Biological, chemical, geological, and physical oceanography.

MASTER OF SCIENCE

Admission requirements: GRE (verbal, quantitative and advanced sections) and bachelor's degree (B average) in some field of the natural sciences or engineering. Applicants are admitted for September only. Due to the limited number of students that can be accepted as degree candidates, no application will be considered showing an

undergraduate average of less than B unless there is post-baccalaureate work indicating outstanding ability. Applications should be completed by February 15.

Program requirements: thesis; OCG 501, 521, 540, 561, 695; participation in a regular ocean research cruise.

DOCTOR OF PHILOSOPHY

Admission requirements: GRE (verbal, quantitative and advanced sections); master's degree is not required, but bachelor's degree (B average) in some field of natural sciences of engineering. Applicants are admitted for September only. Due to the limited number of students that can be accepted as degree candidates, no application will be considered showing an undergraduate average of less than B unless there is post-baccalaureate work indicating outstanding ability. Applications should be completed by February 15.

Program requirements: B grade in core courses, OCG 501, 521, 540, 561; six additional course credits in oceanography at the 600 level (excluding problems and research courses and OCG 695); participation in regular ocean research cruise. Although there is no general language requirement, the individual student's major professor may require him to demonstrate ability in one or more foreign languages.

SPECIAL FINANCIAL AID

There is a limited number of research assistantships and traineeships for master's and doctoral candidates.

PHARMACOGNOSY

M.S., Ph.D. (Pharmaceutical Sciences)

GRADUATE FACULTY

Professor Worthen, *chairman*. Professor Youngken; Associate Professor Shimizu; Assistant Professor Lyon.

SPECIALIZATIONS

Biosynthesis of drug plant constituents; natural product chemistry; screening of natural products for physiologically-active agents, including materials from both land and marine sources.

MASTER OF SCIENCE

Admission requirements: GRE, bachelor's degree in pharmacy, chemistry or biology.

Program requirements: thesis; PCG 445, 446, or equivalent; PCG 548, PCL 441, 442, or equivalent; CHM 425; BCH 581, 582.

DOCTOR OF PHILOSOPHY (Pharmaceutical Sciences)

Admission requirements: GRE and master's degree in pharmacy, chemistry or biology, or bachelor's degree in one of these with evidence of superior ability.

Program requirements: PCG 551, 552, 633, 634. A candidate entering the Ph.D. program with a bachelor's degree must also meet the M.S. program requirements.

PHARMACOLOGY AND TOXICOLOGY

M.S., Ph.D. (Pharmaceutical Sciences)

GRADUATE FACULTY

Professor DeFeo, *chairman*. Professors Lal, DeFanti; Associate Professor Fuller; Assistant Professors Carlson, Swonger; Adjunct Associate Professor Robinson; Adjunct Assistant Professors Karkalas, Pogacar.

SPECIALIZATIONS

Behavioral, biochemical, cardiovascular, environmental, and marine pharmacology; toxicology; forensic toxicology.

MASTER OF SCIENCE

Admission requirements: GRE and bachelor's degree with science major.

Program requirements: thesis; mathematics through calculus; physical chemistry; one course in statistics; principles of pharmacology; PCL 441, 442, 521, 522. Other courses and research training will be included to complete the program, in accordance with the student's interest and background.

DOCTOR OF PHILOSOPHY (Pharmaceutical Sciences)

Admission requirements: GRE and bachelor's or master's degree with science major.

Program requirements: M.S. degree must be earned prior to Ph.D. if admission is granted

without it. Additional courses and special training included according to the requirements of each student's program. Independent research topics will be selected in accordance with the student's interests.

PHARMACY

M.S., Ph.D. (Pharmaceutical Sciences)

GRADUATE FACULTY

Professor Ballard, *chairman*. Professors Osborne, Paruta; Assistant Professors Cooper, Fish, Lausier.

SPECIALIZATIONS

Physical pharmacy, manufacturing and formulation of pharmaceuticals, quality control, biopharmaceutics, hospital pharmacy, clinical pharmacy.

MASTER OF SCIENCE

Admission requirements: GRE and bachelor's degree in pharmacy, a physical science or equivalent.

Program requirements: for thesis option, thesis, PHC 521, 522, one modern foreign language strongly recommended. For non-thesis option: PCH 521, 522, 611, 612, 625, 626, 662; PCL 644.

DOCTOR OF PHILOSOPHY (Pharmaceutical Sciences)

Admission requirements: same as for master's degree.

Program requirements: PHC 521, 522.

PHARMACY ADMINISTRATION

M.S.

GRADUATE FACULTY

Associate Professor Campbell, *chairman*. Associate Professors Crombe, Jacoff; Clinical Professor Uhl.

SPECIALIZATIONS

Development and utilization of pharmacy resources in health care systems involving the organization, financing, and delivery of health care services and materials.

MASTER OF SCIENCE

Admission requirements: GRE or MAT and bachelor's degree in pharmacy, social sciences, or allied fields.

Program requirements: thesis; PAD 599, 621, 622.

SPECIAL FINANCIAL AID

Fellowships from the American Foundation for Pharmaceutical Education.

PHILOSOPHY

M.A.

GRADUATE FACULTY

Professor Freeman, *chairman*. Professor Martin; Associate Professors Schwarz, Young; Assistant Professors Fedoryka, Hanke, Kim, Peterson, Wenisch, Zeyl; Instructor Kowalski.

SPECIALIZATIONS

History of philosophy, philosophical logic, philosophy of religion, epistemology, metaphysics.

MASTER OF ARTS

Admission requirements: GRE.

Program requirements: thesis, comprehensive examination and a language, French or German preferred.

PHYSICAL EDUCATION

M.S.

The graduate program in physical education is open to both men and women.

GRADUATE FACULTY

Associate Professor Zarchen, *chairman*, Associate Professor Nedwidek, *coordinator*, Department of Physical Education for Men; Professor Massey, *chairman*, Physical Education for Women. Professors Cieuzo, Slader; Associate Professors Crooker, Leathers, Mandell; Assistant Professors Bloomquist, DelSanto, McCormick, O'Donnell, Polidoro, Sherman, Sonstroem.

SPECIALIZATIONS

Health education, recreation education, physical

education for mentally retarded, and psychology of sport.

MASTER OF SCIENCE

Admission requirements: MAT or GRE with B.S. degree in physical education, health and physical education, or health education. In exceptional cases, a candidate without a physical education major, but with a strong emphasis in physical education, is accepted.

Program requirements: thesis (30 credit hours) and PED 510, 530, 520, 550; for non-thesis option (33 credit hours), PED 510, 530, 520, and 591. Non-thesis option requires oral examination in addition to written comprehensives.

PHYSICS

M.S., Ph.D.

GRADUATE FACULTY

Professor Dietz, *acting chairman*. Professor A. Quirk; Associate Professors Desjardins, Hartt, Letcher, Malik; Assistant Professor Choudry, Cuomo, Kaufman, Kirwan, Northby.

The department offers courses leading to the degrees of Master of Science (with or without thesis) and Doctor of Philosophy. At the doctoral level, research is concentrated in the areas of neutron physics and liquid state physics. Neutron scattering, diffraction, and radiational experiments are carried out at the Rhode Island Nuclear Science Center at the Narragansett Bay Campus and in conjunction with Brookhaven National Laboratory.

Liquid state research includes studies of physical acoustics, underwater acoustics, infrared spectroscopy, Brillouin scattering, and liquid helium studies. The department has a 16-inch reflecting optical telescope developed for photography and dual-channel photometry. Theoretical research areas include nuclear and particle physics.

SPECIALIZATIONS

Neutron diffraction and scattering, hypernuclear physics, ultrasonic studies in liquid crystals and metals, underwater propagation of acoustic waves, infrared spectrophotometry, propagation of waves in stochastic media, Brillouin scattering, liquid helium, few nucleon systematics, computa-

tional physics, color centers, radiation effects in solids.

MASTER OF SCIENCE

Admission requirements: GRE with advanced test and bachelor's degree with major in physics preferred.

Program requirements: thesis and PHY 520, 530, 570, 580. For non-thesis option, the student shall complete 36 course credits, with at least one course requiring a substantial paper involving significant independent study. Twelve of the course credits shall be in the 500- or 600-level physics courses that are in addition to those core courses required of all master's degree candidates. The non-thesis student shall successfully complete a final oral examination that will not exceed one and one-half hours in length.

DOCTOR OF PHILOSOPHY

Admission requirements: GRE with advanced test and bachelor's degree with major in physics preferred. Master's degree is not required.

Program requirements: PHY 510, 511, 520, 530, 531, 570, 571, 580, 620, 650, 660 and either 651 or 661. There is no formal departmental language requirement; however, the candidate's committee may require language proficiency.

PLANT AND SOIL SCIENCE

M.S.

GRADUATE FACULTY

Professor Larmie, *chairman*. Professors Shutak, Skogley, Stuckey, Wakefield; Associate Professors Brown, Gould, Hindle, Hull, McGuire; Assistant Professors Duff, Jagschitz.

Work beyond the M.S. degree in plant and soil science may be developed in cooperation with other departments offering the Ph.D. degree in biological sciences.

SPECIALIZATIONS

Emphasis on one or more of the following plant commodities: turfgrasses, woody ornamentals, flowers, fruits, vegetables, and field crops. Specific programs may feature one or more of the following: soil-plant-climate relationships, physiology, post-harvest physiology, propagation, ecol-

ogy, weed science and plant breeding. Work with radioisotopes, growth regulators and mineral nutrients is considered basic. Plant associations such as exist in the home landscape, along roadsides, and in salt marshlands are suitable for ecological study.

MASTER OF SCIENCE

Admission requirements: GRA and an undergraduate major in agronomy, horticulture, botany, soil science-plant science, or any of the natural sciences.

Program requirements: thesis and background study in plant and soil science, botany, chemistry and statistics.

PLANT PATHOLOGY-ENTOMOLOGY

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY

Professor Traxler, *chairman*. Professors Beckman, Kerr; Associate Professors Jackson, Mueller; Assistant Professor Field; Adjunct Professors Kaplan, Tarzwell.

SPECIALIZATIONS

Plant pathology, plant virology, economic entomology, water quality, biodegradation, fine structure.

MASTER OF SCIENCE

Admission requirements: GRE with undergraduate major in biological, agricultural or physical sciences.

Program requirements: thesis and seminars.

DOCTOR OF PHILOSOPHY (Biological Sciences)

Admission requirements: GRE and bachelor's or master's degree in biological, agricultural or physical sciences.

Program requirements: dissertation and participation in seminars.

POLITICAL SCIENCE

M.A., M.P.A.

GRADUATE FACULTY

Professor Warren, *chairman*. Professors Wood, Zucker; Associate Professors Leduc, Milburn,

Stein; Assistant Professors Grossbard, Killilea, Tyler.

SPECIALIZATIONS

American government, international relations, politics of the developing areas, urban affairs, comparative governments, public administration.

MASTER OF ARTS AND MASTER OF PUBLIC ADMINISTRATION

Admission requirements: GRE or MAT with undergraduate credit in basic political science and political theory.

Program requirements: thesis and non-thesis option; PSC 553. Non-thesis option for M.A. degree requires oral examination in addition to comprehensives. Internship program required for M.P.A.

Interdisciplinary programs involving 15-18 additional credits in associated fields lead to graduate certificates in North Atlantic Regional Studies and in International Development awarded by the Dean of the Graduate School as adjuncts to the M.A. in political science. See International Studies.

PSYCHOLOGY

M.S., Ph.D.

GRADUATE FACULTY

Assistant Professor Berman, *acting chairman*.

Full-time: Professors Archer, Berger, A. J. Lott, Merenda, Vosburgh; Associate Professors Biller, Cain, Camp, Grebstein, Silverstein, Smith, Willoughby; Assistant Professors Berk, Gross, Makonian, O'Keefe, Prochaska, Stevenson, Valentino, Velicer.

Part-time: Associate Professor B. Lott; Clinical Professors Mohrnhelm, Musiker, Redmon; Clinical Associate Professors Richardson, Silverman, Karkalas, Micotra.

Clinical Associate: Antonelli.

SPECIALIZATIONS

Clinical, general-experimental and school psychology; neuropsychology, verbal learning, psychotherapeutic models and outcome, clinical psychodiagnosis, clinical-child, measurement, group dynamics, physiological-sensation, community practices, personality and rehabilitation, alcoholism, exceptional child, aversive conditioning, be-

havioral modification techniques, learning disabilities, social learning. Specialization in psychopharmacology is interdepartmental with the Department of Pharmacology.

MASTER OF SCIENCE (school psychology only)

Admission requirements: MAT and GRE with advanced test; undergraduate major in psychology recommended. Applicants are admitted for September only. Applications must be completed by February 15.

Program requirements: non-thesis (45 to 54 credits); one semester internship.

DOCTOR OF PHILOSOPHY (clinical, general-experimental, and school psychology)

Admission requirements: MAT and GRE with advanced test; evidence of research competency. Applicants are admitted for September only. Applications must be completed by February 15. Prospective applicants are asked to address initial inquiries concerning the desired specialization to the department, but formal application materials must be obtained from and returned directly to the Graduate School Office. Applicants to clinical program having post-baccalaureate experience are given special consideration.

Due to limited facilities, new admissions to the doctoral programs in clinical and school psychology must be limited to a small number per year. Although test scores and cumulative averages are not the sole criteria for admission, those with overall quality point averages of less than 3.0 on a 4.0 scale, or with GRE or MAT scores below the 50th percentile (using psychology norms for the MAT) are advised that there is no realistic chance for admission to these programs where so few of those with better academic qualifications can be accommodated.

Program requirements: academic core of 18 credits including developmental, social, personality, learning, cognitive perceptual processes, and physiology; research tools, design, and methodology (6 credits); intermediate quantitative methods and methods of psychological research and experimental design; minimum of 18 research credits; two semesters individual and practical teaching in psychology. Additional requirements are imposed to meet the demands of each specific program area.

The clinical psychology doctor of philosophy program is provisionally accredited by the American Psychological Association.

RESOURCE ECONOMICS

M.S.

For interdepartmental Ph.D. degree program, see Economics, Marine Resource Option.

GRADUATE FACULTY

Professor Cummings, *chairman*. Professors Holmsen, Lampe, Norton, Owens, Rorholm, Spaulding; Associate Professor Wallace; Assistant Professors Gates, Grigalunas, McConnel, McFarland, Seay, Weaver; Instructor Hueth.

SPECIALIZATIONS

Econometrics, mathematical economics and resource economics, marine economics, market and price analysis, production economics.

MASTER OF SCIENCE

Admission requirements: GRE or MAT and bachelor's degree with strong background in the social sciences, statistics, or mathematics.

Program requirements: 24 credit hours plus thesis.

SOCIOLOGY

M.A.

GRADUATE FACULTY

Associate Professor Poggie, *chairman*. Professors England, Rosengren, Spaulding; Associate Professors Bouvier, Gardner, Gersuny; Assistant Professors Sennott, Travisano; Instructors Bassis, Carroll.

SPECIALIZATIONS

Population and demography, race relations, medical sociology, criminology, resource development, culture and personality, complex organizations, sociology of education, deviance.

MASTER OF ARTS

Admission requirements: MAT (preferred) or GRE including advanced sociology; strong background in social sciences. B.A. degree in sociology preferred.

Program requirements: for thesis program, 24 credits comprised of at least six 500-level courses,

including SOC 502, 505, 506; at least two other 500-level sociology courses; thesis; familiarity with theory and methods sections of the department's M.A. reading list; oral examination on that literature and on thesis. For non-thesis program: 30 credits comprised of at least seven 500-level courses, including SOC 502, 505, 506; at least three other 500-level sociology courses; familiarity with theory and methods sections of the reading list plus two additional sections; written and oral comprehensive examinations based on that literature.

SPANISH

M.A.

GRADUATE FACULTY

Associate Professor Kossoff, *chairman*, Department of Languages. Professor Hutton; Assistant Professors Freedman, Navascués.

SPECIALIZATIONS

Spanish literature or the literature of the Spanish-speaking world.

MASTER OF ARTS

Admission requirements: MAT or GRE; undergraduate major in Spanish or equivalent, including 12 credits in Spanish or Hispanic-American literature. Qualified students may be admitted with less than 12 credits but must make them up without graduate credit.

Program requirements: all work carried out in Spanish. For thesis option, SPA 591, seven courses (21 credits), and thesis (6 credits). For non-thesis option, SPA 591, and nine courses (27 credits).

SPEECH PATHOLOGY AND AUDIOLOGY

M.A., M.S.

GRADUATE FACULTY

Assistant Professor Jirsa, *director of graduate programs*. Professors Beaupre, Doody, FitzSimons; Associate Professor Bailey; Assistant Professors Arnst, Grubman; Clinical Assistant Professor Regan; Clinical Supervisor Finck.

SPECIALIZATIONS

Audiology and speech pathology.

MASTER OF ARTS AND MASTER OF SCIENCE

Admission requirements: MAT or GRE (in special cases); 24 undergraduate credit hours in general speech, speech science, speech development, child development, psychology, or education.

Program requirements: for M.A. in speech pathology (36 credit hours), thesis, SPE 504, 24 credit hours in speech pathology, 6 credit hours in audiology. For M.A. in audiology (36 credit hours), thesis, SPE 504, 24 credit hours in audiology, 6 credit hours in speech pathology. For M.S. in speech pathology (39 credit hours), no thesis, SPE 504, 30 credit hours in speech pathology, 6 credit hours in audiology. For M.S. in audiology (39 credit hours), no thesis, SPE 504, 30 credit hours in audiology, 6 credit hours in speech pathology.

TEXTILES, CLOTHING AND RELATED ART

M.S.

GRADUATE FACULTY

Professor V. V. Carpenter, *chairman*. Associate Professor Fry; Assistant Professors Harabin, Helms, Gilbert, Weeden.

SPECIALIZATIONS

Social science aspect of textiles and clothing, physical science aspect of textiles and clothing, historic textiles and costume.

MASTER OF SCIENCE

Admission requirements: GRE or MAT and undergraduate degree in textiles and clothing, social science or allied fields.

Program requirements: thesis or non-thesis option, 30 credits. For thesis option, TXC 524, 580; courses in statistics recommended. For non-thesis option, TXC 524, 550, 560, 570.

ZOOLOGY

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY

Professor Chipman, *chairman*. Professors Hammen, Harrison, Hyland, Saila, Winn, Zinn; Asso-

ciate Professors Constantino, Goertemiller, Heppner, Hill, Krueger, Mathewson, Shoop; Assistant Professors Bibb, Cobb, Kass-Simon, Surver; Adjunct Professors Dowling, Gibbs, Schaefer.

SPECIALIZATIONS

Acarology, animal behavior, cytology, ecology, embryology, entomology, fisheries biology, genetics, herpetology, histology, ichthyology, invertebrate zoology, limnology, mammalogy, ornithology, parasitology, physiological ecology, physiology, radioecology, reproductive biology, taxonomy.

MASTER OF SCIENCE

Admission requirements: GRE with advanced test (biology) and bachelor's degree with major in zoology, biology or allied field.

Program requirements: thesis; ZOO 595, 596.

DOCTOR OF PHILOSOPHY (Biological Sciences)

Admission requirements: master's degree is not required. GRE with advanced test (biology) and bachelor's degree with major in zoology, biology or allied field.

Program requirements: dissertation, two languages (one of which may be substituted with faculty approval), ZOO 595, 596.

MORRILL



F = Fall 73 (as of 12/13/73 course
enrollments)

S = Spring 74 (as of 5/1/74 course
enrollments)

Courses of Instruction

All graduate-level courses are described in full on the following pages. Undergraduate courses numbered at the 400 level, permitted for graduate credit in some cases, are described in the *Undergraduate Bulletin* and are listed here for reference only. Courses at the 500 level comprise the majority of course work between the bachelor's and the master's degrees. Those at the 600 level are advanced graduate courses. The 900 level courses are special types of graduate courses including graduate courses for which no degree credit is given. They include courses offered to remedy deficiencies as well as workshops, institutes, and courses offered one time only by visiting faculty.

Courses with two numbers, e.g. APA 501, 502, indicate a year's sequence and the first course is either a prerequisite for the second or at least the two cannot be taken in reverse order without special permission. Parentheses after a course number enclose either the old course number, or, in cases of multiple listings, the departments and numbers under which the course is also offered.

The roman numeral indicates the semester the course will normally be offered; some courses, however, are offered only in alternate years and a few less frequently. The *Schedule of Courses* issued by the registrar at the November and May registration period must therefore be consulted to determine which courses will be offered in the following semester. The arabic numeral indicates the credit hours; distribution of class hours each week is in parentheses. The instructor's name follows the course description.

ACCOUNTING (ACC)

- | | |
|---|--------------------|
| 413 Contemporary Accounting Issues | I, 3 |
| 422 Advanced Cost Accounting | II, 3 |
| 431 Advanced Accounting | II, 3 |
| 443 Federal Tax Accounting | I, 3 |
| 444 (544) Topics in Federal Taxation | II, 3 |
| 461 Auditing | II, 3 |
| F 510 (910) Financial Accounting | I and II, 3 |
| S Concepts of financial accounting in the analysis and interpretation of financial statements; emphasis on accounting principles. (Lec. 3) Staff | |
| F 513 Accounting Systems | I, 3 |
| S Principles and problems related to design and installation of accounting control systems with emphasis on automated data processing. (Lec. 3) Prerequisite: ACC 312 and permission of department. Staff | |
| S 535 Advanced Problems in Accounting | II, 3 |
| S General and specialized accounting problems that constitute the subject matter of CPA examinations. (Lec. 3) Prerequisite: ACC 431. Staff | |
| S 548 Accounting for Non-Commercial Entities | II, 3 |
| S Principles and practices of fund accounting as applied to municipalities, educational institutions, hospitals and similar organizations, with particular emphasis upon municipal records and statements. (Lec. 3) Prerequisite: permission of instructor. Staff | |

- 611 Managerial Accounting** *I and II, 3*
 Determination of accounting information for the purposes of decision making, control, and evaluation with emphasis on decision models using accounting information. (Lec. 3) *Prerequisite:* ACC 510. Staff
- 699 Doctoral Dissertation Research** *I and II*
 Number of credits is determined each semester in consultation with the major professor or program committee.

- 618 Current Accounting Theory** *I, 3*
 A critical examination of accounting theory and practice designed to develop research techniques with emphasis on financial accounting. (Lec. 3) *Prerequisite:* ACC 510. Staff

- 619 Current Accounting Theory** *II, 3*
 A critical examination of accounting theory and practice designed to develop research techniques with emphasis on managerial accounting. (Lec. 3) *Prerequisite:* ACC 321 or 611. Staff

ANIMAL PATHOLOGY (APA)

- 401 Introduction to Pathology** *I or II, 3*

- 422 Avian Diseases** *II, 3*

- 461 Laboratory Animal Technology** *I, 3*

- 501, 502 Seminar** *I and II, 1 each*
 Preparation and presentation of scientific papers on selected subjects in animal pathology and virology. Staff

- 534 Animal Virology** *II, 3*
 Basic properties, classification and evolution of animal viruses. Individual agents are studied in detail. (Lec. 3) *Prerequisite:* MIC 432, 533 and permission of department. Yates and Chang

- 536 Virology Laboratory** *II, 2*
 Methods employed in diagnosis and for the investigation of the biological, physical, and chemical properties of animal viruses. (Lab. 6) *Prerequisite:* APA 534. (May be taken simultaneously.) Yates and Chang

- 538 Epidemiology of Viral and Rickettsial Diseases** *II, 2*
 Principles of epidemiology. Interrelationships of host, environment and agent in viral and rickettsial diseases. (Lec. 2) *Prerequisite:* APA 534. (May be taken simultaneously.) In alternate years, next offered 1973-74. Chang

- 591, 592 Special Projects** *I and II, 1-3 each*
 Research projects in animal pathology and virology. *Prerequisite:* permission of department. Staff

- 599 Masters Thesis Research** *I and II*
 Number of credits is determined each semester in consultation with the major professor or program committee.

ANIMAL SCIENCE (ASC)

- 401, 402 Animal Science Seminar** *I and II, 1 each*

- 412 Animal Nutrition** *II, 3*

- 414 Advanced Ration Formulation** *II, 3*

- 415 Physiology of Lactation** *I, 3*

- 432 Biology of the Fowl** *II, 3*

- 441 Food Analysis** *I, 3*

- 442 Animal Breeding** *II, 3*

- 444 Food Quality** *II, 3*

- 461 (or APA 461) Laboratory Animal Technology** *I, 3*

- 470 Population Genetics** *II, 3*

- 472 Physiology of Reproduction** *II, 3*

- 491, 492 Special Projects** *I and II, 1-3 each*

- 512 Advanced Animal Nutrition** *II, 3*
 Comparative digestion and metabolism of protein, carbohydrate, and fat by ruminant and nonruminant animals. The role of vitamins and minerals in metabolism. Experimental methods in animal nutrition will be discussed. Emphasis on the ruminant animal. (Lec. 2, Lab. 2) *Prerequisite:* ASC 412, CHM 124 or BCH 581 and permission of department. In alternate years, next offered 1973-74. Hinkson

- 532 (or EST 532 or PSY 532) Experimental Design**
 See Experimental Statistics 532.

- 591, 592 Research Problems** *I and II, 3 each*
 Research problems to meet individual needs of graduate and honors students in the fields of animal breeding, nutrition, or physiology and food science. (Lab. 6, TBA) *Prerequisite:* permission of department. Staff

- 599 Masters Thesis Research** *I and II*
 Number of credits is determined each semester in consultation with the major professor or program committee.

Note: for Biochemistry of Foods, see FRC 431, 432.

ANTHROPOLOGY (APG)

- 401 History of Anthropological Theory *I or II, 3*
 402 Methods of Anthropological Inquiry *I or II, 3*
 405 Psychological Anthropology *I or II, 3*
 407 Economic Anthropology *I or II, 3*
 470 Problems in Anthropology *I and II, 3*

ART (ART)

- 403 Studio—Seminar I *I and II, 3-6*
 404 Studio—Seminar II *I and II, 3-6*
 405 Studio—Seminar III *I and II, 3-6*
 406 Studio—Seminar IV *I and II, 3-6*
 462 Modern Art Seminar: Art since 1945 *II, 3*
 469, 470 Art History—Senior Projects *I and II, 3-6 each*

501 Graduate Studio—Seminar I *I and II, 3-12*
 Intensive independent studio work under the guidance of appropriate advisers. Periodic critiques and discussions related to work of all participants in the course. (Studio 6-24) Prerequisite: permission of department. Staff

502 Graduate Studio—Seminar II *I and II, 3-12*
 Continuation of ART 501. (Studio 6-24) Prerequisite: permission of department. Staff

ASTRONOMY (AST)

- 408 Introduction to Astrophysics *II, 3*

BIOCHEMISTRY (BCH)

- 400 Chemistry and Biochemistry of Carbohydrates *II, 3*

- 411 Biochemistry Laboratory *II, 3*

531, 532, 533, 534 Seminar in Biochemistry *I and II, 1 each*
 Presentation of a seminar on selected topics in contemporary biochemistry. (Lec. 1) Prerequisite: permission of department. Staff

541, 542 Laboratory Techniques in Biochemistry *I and II, 3 each*
 Study and application of these biochemical techniques: enzyme preparation and purification, cell

fractionation, ion-exchange and paper chromatography, manometry, fluorometry, polarography, radioactive tracer techniques as applied to biochemical research problems. Assigned research on advanced level using above techniques. (Lab. 9) Prerequisite: permission of department. Purvis and Dain

581, 582 General Biochemistry *I and II, 3 each*
 Systematic treatment of the principles of biochemistry. A basic course dealing with the chemistry of biological substances and the transformations in living organisms. (Lec. 3) Prerequisite: CHM 221, 222. Staff

599 Masters Thesis Research *I and II*
 Number of credits is determined each semester in consultation with the major professor or program committee.

601 Enzymes *I, 3*
 Factors affecting the rate of catalysis in enzymic reactions. The thermodynamic and kinetic characteristics of enzymes' profiles. (Lec. 1 1/2, Lab. 8) Prerequisite: BCH 581, 582, and/or permission of department. In alternate years, next offered 1973-74. Purvis and Tremblay

602 The Mitochondrion *II, 3*
 Detailed study of the structure, properties and functions of the mitochondrion. (Lec. 3) Prerequisite: BCH 581, 582, and/or permission of department. In alternate years, next offered 1973-74. Purvis

611 Intermediary Metabolism *I, 3*
 Intensive study of the metabolic pathways of carbohydrates, lipids and nitrogenous compounds and their interrelationships. The effects of hormonal and nutritional status on the activity of these pathways. (Lec. 3) Prerequisite: BCH 581, 582, and/or permission of department. In alternate years. Purvis and Tremblay

612 Biochemical Regulation of Cellular Metabolism *II, 3*
 Biochemical regulatory mechanisms of cellular metabolism in micro-organisms and mammalian systems, at the level of the genome, protein synthesis and enzyme catalysis. (Lec. 3) Prerequisite: BCH 581, 582, and/or permission of department. In alternate years. Tremblay

699 Doctoral Dissertation Research *I and II*
 Number of credits is determined each semester in consultation with the major professor or program committee.

BIPHYSICS (BPH)

- 401 Quantitative Cell Culture *I, 3*

521 Introductory Biophysics *I, 3*
 The use of viscosity, diffusion, ultracentrifugation, light scattering, spectrophotometry and X-ray diffrac-

tion to study the size, shape, structure, and molecular weight of biological macromolecules. (Lec. 3) *Prerequisite: CHM 332 and MTH 243.* Hartman

522 Intermediate Biophysics *II, 3*
Molecular structure, physical chemistry and genetics of viruses and nucleic acids. (Lec. 3) *Prerequisite: BPH 521. In alternate years, next offered 1973-74.* Hartman

523, 524 Special Topics in Biophysics *I and II, 1-6 each*
Advanced work arranged to suit the individual needs of the student. Lecture and/or laboratory according to the nature of the problem. Credits not to exceed a total of 12. *Prerequisite: permission of department.* Staff

526 Nuclear and Radiation Physics in Biology *II, 4*
Fundamental aspects of radioactivity; alpha and beta particles and gamma rays, radiation detection; application of tracer techniques to biological systems; interaction of high energy radiations with matter and with biological systems; health physics and disposal of radioactive wastes. (Lec. 2, Lab. 6) *Prerequisite: CHM 332 or PHY 340 and BIO 102 or permission of department. In alternate years, next offered 1973-74.* Fisher

595, 596 Seminar *I and II, 1 each*
Presentation of papers on selected subjects in biophysics. (Lec. 1) *Required of all graduate students in biophysics.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

611 Advanced Biophysics *I, 3*
Physical and chemical properties of macromolecules in solution. (Lec. 3) *Prerequisite: BPH 521 or permission of department. In alternate years.* Fisher

621 Electron Microscopy *I, 4*
Introduction to electron microscopy, electron optics, maintenance and operation; techniques of specimen preparation for particulate materials, spraydrop, suspensions, freeze drying, critical point drying, shadow casting, negative staining, fixation, and ultramicrotomy. (Lec. 2, Lab. 6) *Prerequisite: permission of department.* Fisher and Staff

651, 652 Research in Biophysics *I and II, 3 each*
Student is required to outline a research problem, conduct necessary literature survey and experimental work and present his observations and conclusions in a report. (Lab. 6) *Prerequisite: graduate standing.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

BOTANY (BOT)

402 Systematic Botany *I, 3*

417 Methods in Aquatic Plant Ecology *I, 3*

418 Marine Botany *II, 3*

419 Freshwater Botany *II, 3*

421 Advanced Practicum in Aquatic Plant Ecology *II, 3*

424 Plant Ecology *II, 3*

432 Mycology: Introduction to the Fungi *I, 4*

445 (442) Advanced Plant Physiology *II, 3*

453 Cytology *I, 3*

455 Marine Ecology *I, 3*

457 Marine Ecology Laboratory *I, 1*

511 Developmental Plant Anatomy *II, 3*
Ontogeny of plant structures is studied from zygote through seed production, with emphasis on recent experimental studies which elucidate the morphogenetic mechanisms. Ecological anatomy is included. (Lec. 2, Lab. 3) *Prerequisite: BOT 311 or equivalent. In alternate years, next offered 1974-75.* Hauke

512 Morphology of Vascular Plants *II, 3*
Comparative survey of development, form and anatomy of extinct and extant vascular plants and a modern interpretation of evidence concerning their interrelationships. (Lec. 2, Lab. 2) *Prerequisite: BOT 311 or equivalent. In alternate years.* Hauke

524 Methods in Plant Ecology *I, 3*
Methods used in the analysis of vegetation and microenvironments. Emphasis on quantitative techniques in analysis of vegetation, soil and microclimate, and techniques in physiological ecology. (Lec. 2, Lab. 2) *Prerequisite: BOT 111 and 424 or equivalent; EST 411, 412 desirable. In alternate years.* Halvorson

526 (or GEG 526) Plant Geography *I, 3*
Environmental and non-environmental factors controlling distribution of species and vegetative types; the origin, development and senescence of floras; distribution of modern vegetation types and theories of modern-day species distribution. (Lec. 2, Lab. 2) *Prerequisite: BOT 402, 424, or permission of department. In alternate years, next offered 1973-74.* Halvorson

534 Physiology of the Fungi *I, 3*
Life processes of fungi with particular emphasis on chemical composition, organic and mineral nutrition, toxic and stimulating agencies, and metabolism. Also stresses phenomena of variation of growth and sporu-

lation as affected by various environmental factors. (Lec. 2, Lab. 2) *Prerequisite: BOT 332, or permission of department. In alternate years, next offered 1973-74.* Caroselli

536 Phytopathological Technique *I, 3*
Research procedures in plant pathology including isolation and inoculation practices, maintenance of pathogenes, disease diagnosis, use of techniques for determining fungi-toxic and phytotoxic properties of chemicals, use of literature and method of preparing manuscripts. (Lec. 1, Lab. 4) *Prerequisite: BOT 332 or permission of department. In alternate years.* Caroselli

540 Experimental Mycology *II, 3*
Growth and reproduction of fungi as affected by nutritional, environmental and genetic factors, with emphasis on experimental methods. (Lec. 1, Lab. 4) *Prerequisite: BOT 432 and MIC 201, or permission of instructor. In alternate years, next offered 1973-74.* Goos

542 Medical Mycology *II, 3*
Study of fungi pathogenic for man and animals. (Lec. 2, Lab. 2.) *Prerequisite: BOT 432 or MIC 201, or permission of instructor.* Goos

554 Cytogenetics *I, 4*
Comparisons of various types of crossing-over, chromosomal aberrations and their effects, mutation and other cytogenetic phenomena in fungi and higher organisms. Laboratory studies of meiosis in maize, identification of chromosomes and induced rearrangements. (Lec. 2, Lab. 4) *Prerequisite: BOT 352, 453, or permission of instructor.* Mottinger

559 Physiological Ecology of Marine Macroalgae *I, 4*
Comparative studies designed to investigate those environmental factors regulating distribution, physiology and development of macroalgae through field, laboratory and library research. (Lec. 2, Lab. 4) *Prerequisite: BOT 416 or equivalent, or permission of instructor. In alternate years, next offered 1973-74.* Harlin

562 Seminar in Plant Ecology *II, 2*
Discussion of recent topics and investigations pertinent to plant ecology. Involves library research, oral presentation of reports, and group discussions. (Lec. 2) *Prerequisite: BOT 424 or equivalent, and permission of instructor.* Halvorson

579 Advanced Genetics Seminar
See Zoology 579.

581, 582 Botany Seminar *I and II, 1 each*
Preparation and presentation of papers on subjects in selected areas relating to botany. (Lec. 1) *Prerequisite: required of graduate students majoring in botany.* S/U credit. Staff

591, 592 Botanical Problems *I and II, 1-3 each*
Special work arranged to meet the needs of individual students who are prepared for and desire advanced

work in botany. Offered only by arrangement with staff. (Lec. 1-3, Lab. 2-6) Staff

593, 594 Botanical Problems *I and II, 1-3 each*
Similar to BOT 591, 592, but arranged to meet needs of students desiring further advanced work in botany. Offered only by arrangement with staff. (Lec. 1-3, Lab. 2-6) Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

616 The Biogeography of Marine Algae *II, 3*
Marine algae of the world, with consideration of the global distribution of taxa, geographic-ecologic ranges, and economic aspects. (Lec. 2, Lab. 3) *Prerequisite: permission of instructor. In alternate years, next offered 1974-75.* Wood

640 (631-635) Advanced Mycology Seminar *I and II, 1 each*
Specialized and advanced treatment of biology and research in the major groups of the fungi, including systematics, physiology, and ecology. (Lec. 1) *Prerequisite: permission of instructor. May be repeated.* Goos

645 (545) Environmental Plant Physiology *I, 3*
Environmental parameters influencing growth and development of the cellular and organismic levels of organization through physiological control mechanisms. Emphasis on flowering plants. (Lec. 3) *Prerequisite: BOT 445, BCH 582 or FRC 452 or equivalent, or permission of instructor. In alternate years, next offered 1973-74.* Albert

661 Phytoplankton Taxonomy
See Oceanography 661.

663 Phytoplankton Physiology
See Oceanography 663.

664 Phytoplankton Ecology
See Oceanography 664.

667, 668, 669 Advanced Phytoplankton Seminars
See Oceanography 667, 668, 669.

691, 692 Botanical Problems *I and II, 1-6 each*
Special work to meet needs of individual students who are prepared to undertake special problems. (Lec. 3 or Lab. 6) *Prerequisite: permission of department.* Staff

693, 694 Research in Botany *I and II, 3 each*
Assigned research, subject matter of which is to be arranged with a member of department and with the approval of the head of the department. (Lab. 6) Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

BUSINESS EDUCATION (BED)**428 Coordinating and Developing Curriculum for Cooperative Vocational Business and Distributive Education**

I, 3

520 Research and Methods in Teaching Office Occupations Subjects

I, 3

Psychological principles of skill building, content, methods of teaching, curriculum materials, current thought, and evaluation in the teaching of office occupations subjects. (Lec. 3) Staff

522 Improvement of Instruction in Social Business Subjects

II, 3

Research, objectives, methods of instruction, curriculum materials, current thought, and evaluation in the teaching of such subjects as economics, consumer economics, economic geography, business law, and general business. (Lec. 3) Staff

524 Foundations and Recent Developments in Business Education

II, 3

Philosophy and objectives of business education, principles of curriculum development and evaluation, supervisory problems, organization and administration of cooperative part-time programs, historical developments, legislation, recent developments, and current status of business education. (Lec. 3) Staff

525 Research Seminar in Business Education

I, 3

Analysis of research studies in the field. Research technique applied to business education. Emphasis on the reading, interpretation, and application of research findings to business education. Planning research projects. The planning and approval of an outline for a field study project is a requirement of this course. (Lec. 3) *Prerequisite: a basic course in statistics and permission of department.* Staff

526 Field Study and Seminar in Business Education

I and II, 3

Carrying out of the field study project approved in BED 525 with attendance and participation in seminar meetings. (Lec. 3) *Prerequisite: a basic course in statistics and BED 525.* Staff

BUSINESS LAW (BSL)**500 (900) Legal Environment of Business**

I and II, 2

Outline of American legal system; substantive rules of law in contemporary business environment; legal aspects of business transactions. (Lec. 2) Geffner

CHEMICAL ENGINEERING (CHE)**425 Process Dynamics and Control**

II, 3

437 Materials Engineering

I and II, 3

464 Industrial Reaction Kinetics

I, 3

471 (571) Analysis of Engineering Data

I or II, 3

501, 502 Graduate Seminar

I and II, 1 each

Seminar discussions including the presentation of papers based on research or detailed literature surveys. (Lec. 1) *Attendance is required of all students in graduate residence, but a maximum of 1 credit per year is allowed and no more than 2 credits are allowed for the entire period of residence.* Staff

530 Polymer Chemistry

I, 3

Polymer structure, molecular forces, glass and crystalline transitions, solution properties, polymerization kinetics, molecular weight distribution, fractionation, viscoelastic properties and transport processes. (Lec. 3) *Prerequisite: CHM 222 and 332 or permission of instructor.* Barnett

531 Polymer Engineering

II, 3

Polymer processing and mechanical properties of polymers. (Lec. 3) *Prerequisite: CHE 342 or 344 and 530, or permission of instructor.* Barnett

532 Ceramic Engineering

I, 3

Properties of ceramic materials as related to starting materials and forming, densification and finishing processes. Emphasis on resulting phases and microstructure. Application of physical and chemical principles to tailor properties to engineering needs. (Lec. 3) *Prerequisite: CHE 437 or equivalent.* Rockett

533 Engineering Metallurgy

II, 3

Structures and properties of metals and alloys required to meet typical engineering problems; proper selection of tool materials; properties of stainless steels; materials of special importance in nuclear fields, etc. (Lec. 2, Lab. 3) *Prerequisite: CHE 333 or consent of instructor.* Mairs

534 (or OCE 534) Corrosion and Corrosion Control

I, 3

Chemical nature of metals, electrochemical nature of corrosion. Types of corrosion, influence of environment, methods of corrosion control, behavior of engineering materials, all with special emphasis on the ocean environment. (Lec. 3) *Prerequisite: permission of instructor.* Staff

535 (or OCE 535) Advanced Course in Corrosion

II, 3

The various types of corrosion problems occurring in modern industry. In-depth comparison of the various methods available to avoid, reduce, or eliminate corrosion. Continuation of CHE 534. (Lec. 3) *Prerequisite: CHE 534 or permission of instructor.* Soltz

537 Advanced Materials Engineering

II, 3

Engineering properties, molecular design and applications of materials. Synthesis, fabrication and processing of materials. Effects of environment on materials, materials products devices and systems. (Lec. 3) *Prerequisite: CHE 437 and PHY 340 or 341.* Giellisse

538 Nuclear Metallurgy

See Nuclear Engineering 538.

F 539 Electron and Light Microscopy of Solids I, 3

Theory and physical principles governing the design and use of light and electron optical systems in identification, analysis and structural characterization of metals, ceramics, polymers, glasses and composites. Emphasis on polarized light and scanning electron microscopy. (Lec. 3) *Prerequisite: CHE 437 or equivalent.* Gielisse and Rockett

F 572 X-ray Diffraction and Fluorescence I, 3

Fundamentals, properties, and applications of X-rays for identification and chemical analysis of materials, determination of lattice parameters, phase transformations, textures, residual stresses, grain and particle sizes, film and plate thicknesses. (Lec. 2, Lab. 3) *Prerequisite: PHY 340 or 341.* Mohnheim

5 573 Mechanical Metallurgy I or II, 3

12 Behavior and response of metals to mechanical plastic forming. Property control by analysis and design of industrial metal processing. Principles of annealing, forging, rolling, extruding, rod, wire and tube drawing. Recent advances and developments. (Lec. 3) *Prerequisite: permission of instructor.* Mohnheim

F 574 Biochemical Engineering I, 3

12 Introduction to biotechnology. Includes properties of biological materials, dynamics, control and operation of biological systems and processing of biological materials. (Lec. 3) *Prerequisite: permission of instructor.* In alternate years. Thompson

F 581 Introduction to Nuclear Engineering

See Nuclear Engineering 581.

F 582 Radiological Health Physics

See Nuclear Engineering 582.

5 583 Nuclear Reactor Theory

See Nuclear Engineering 583.

5 585 Measurements in Nuclear Engineering

13 See Nuclear Engineering 585.

5 586 Nuclear Reactor Laboratory

See Nuclear Engineering 586.

F 591, 592 Special Problems I and II, 1-6 each

Advanced work, under the supervision of a member of the staff and arranged to suit the individual requirements of the student. (Lec. or Lab. according to nature of problem. Credits not to exceed a total of 12). *Prerequisite: permission of department.* Staff

F 599 Masters Thesis Research I and II

Number of credits is determined each semester in consultation with the major professor or program committee.

F 613 Advanced Chemical Engineering Thermodynamics I, 2

12 Applications of the first, second and third laws of thermodynamics and their relation to chemical engi-

neering processes. Emphasis on properties of fluids, chemical and physical equilibria and refrigeration. (Lec. 2) in alternate years. Votta

5 614 Advanced Chemical Engineering Thermodynamics II, 2

13 Continuation of CHE 613. (Lec. 2) *Prerequisite: CHE 613.* In alternate years. Votta

6 625 Automatic Process Control II, 3

69 Theory of automatic control as applied to industrial processing systems. (Lec. 3) In alternate years, next offered 1973-74. Shilling

637 (or IDE 641) Molecular Aspects of Materials Processing I or II, 3

Detailed analysis of the fundamental physical and chemical aspects of generation, fabrication and application of materials in processing. Includes major material groups, the molecular nature of material interaction, and the mechanical, chemical, and thermal theories of specific processing modes. (Lec. 3) *Prerequisite: CHE 437 or permission of instructor.* Gielisse

F 640 Transport Phenomena I I, 3

Analysis of transport processes in fluids with emphasis on diffusion of matter. (Lec. 3) *Prerequisite: MTH 244 and CHE 343 or permission of instructor.* Barnett

5 641 Transport Phenomena II II, 3

Interphase transfer, turbulent transport processes and boundary layer theory, with application to fixed and fluid bed processes, membrane processes, biochemical, biomedical and electrochemical systems. (Lec. 3) *Prerequisite: CHE 640.* Barnett

F 643 Fluid Dynamics II, 3

12 Advanced problem course dealing with isothermal and nonisothermal flow of compressible and incompressible fluids. (Lec. 3) In alternate years. Madsen

F 644 Process Heat Transfer II, 3

71 Advanced study of heat transfer by conduction in the steady and unsteady state, radiation and convection. (Lec. 3) In alternate years, next offered 1973-74. Madsen

5 645 (or MCE 645) Boiling Heat Transfer and Two-phase Flow I, 3

12 Nucleation and bubble growth, pool boiling, and flow boiling. Hydrodynamics of two-phase flow, the boiling crisis, and instabilities in boiling systems. (Lec. 3) *Prerequisite: MCE 546, CHE 644 or permission of instructor.* In alternate years, next offered 1973-74. Madsen and Test

646 Radiation Heat Transfer
See Mechanical Engineering 646.**F 647 Mass Transfer I** I, 3

Advanced course dealing with the application of mass transfer theory in the distillation of binary, multi-

component, and complex mixtures. (Lec. 3) *In alternate years, next offered 1973-74.* Thompson

- 5 648 **Mass Transfer II** II, 3
Advanced study of mass transfer theory applied to gas-liquid, liquid-liquid and solid-liquid systems. (Lec. 3) *In alternate years, next offered 1973-74.* Treybal

651, 652 **Advanced Design** I and II, 3 each
Advanced course in the coordination of chemical or nuclear engineering principles and economics to the design of complete industrial plants. Students work design problems on an individual basis, with the guidance of one or more instructors. Staff

- 5 664 **Applied Reaction Kinetics** II, 3
Application of principles of chemical reaction kinetics to industrial processes. (Lec. 3) *In alternate years.* Shilling

682 **Radiation Shielding**
See Nuclear Engineering 682.

- 6 683 **Advanced Nuclear Reactor Theory**
See Nuclear Engineering 683.

687 **Nuclear Chemical Engineering**
See Nuclear Engineering 687.

691, 692 **Special Problems** I and II, 1-6 each
Advanced work, under the supervision of a member of the staff and arranged to suit the individual requirements of the student. (Lec. or Lab. according to nature of problem. Credits not to exceed a total of 12.) *Prerequisite: permission of department.* Staff

- 6 699 **Doctoral Dissertation Research** I and II
Number of credits is determined each semester in consultation with the major professor or program committee.

CHEMISTRY (CHM)

- 401 **Intermediate Inorganic Chemistry** I, 3
412 **Instrumental Methods of Analysis** II, 3
414 **Instrumental Methods of Analysis Laboratory** II, 2
425 **Qualitative Organic Analysis** I, 4
431, 432 **Physical Chemistry** I and II, 3 each

- 5 501 **Advanced Inorganic Chemistry I** I or II, 3
Systematic analysis of bonding schemes and structural aspects of molecular systems encountered in inorganic chemistry. Special emphasis on electron density distributions, physical methods of analysis, and practical applications of quantum mechanics. (Lec. 3) *Prerequisite: CHM 401.* Petersen

- 5 502 **Advanced Inorganic Chemistry II** II, 3
Modern inorganic chemistry approached from experimental, theoretical and descriptive points of view. Includes electronic structure and bonding in coordination chemistry, topology, thermodynamics of complex formation, mechanisms, lanthanides and actinides. (Lec. 3) *Prerequisite: CHM 401 or equivalent.* Staff

- 5 504 **Physical Methods of Inorganic Chemistry** II, 3
Theory and application of principal physical methods used in the preparation, analysis, and investigation of properties of inorganic chemicals, with emphasis on investigations concerning molecular structure and electron density distributions in molecular systems. (Lec. 2, Lab. 3) *Prerequisite: CHM 322.* Petersen

- 5 508 **Inorganic Reaction Mechanisms** II, 3
Kinetics and mechanisms of reactions in aqueous solution treated with regard to techniques, results, and theoretical interpretation. Instrumentation for studying rapid reactions in solution, relaxation methods, electron transfer rates, hydrolytic and solvolytic reactions, metal ion complexation, and reactions of biochemical significance. (Lec. 3) *Prerequisite: CHM 432 or equivalent.* Kirschenbaum

- 5 509 **Advanced Analytical Chemistry I** I, 3
Principles of aqueous and non-aqueous titration. Theory of separations including distillation, solvent extraction, and especially gas and liquid chromatography. Statistical treatment of experimental data. (Lec. 3) *Prerequisite: CHM 412 or permission of instructor.* Staff

- 5 512 **Advanced Analytical Chemistry II** II, 3
Continuation of CHM 412 with emphasis on principles and recent developments in application of physico-chemical phenomena to solution of chemical problems. (Lec. 3) *Prerequisite: CHM 412, PHY 340, and MTH 243.* Staff

- 5 513 **Advanced Analytical Laboratory** I, 3
Projects designed to acquaint student with newer and more advanced techniques of classical and instrumental analytical methods. Literature searches, conferences and a written report required. Course normally required of all first year graduate students in analytical chemistry. (Lab. 9) *Prerequisite: CHM 212, 228, and 432 and permission of department.* Fasching and Rosie

- 514 **Thermal Methods of Analysis** II, 3
Theory and applications of the principles of thermodynamics to the solution of analytical problems. Quantitative treatment will be given to techniques such as differential scanning calorimetry, precision calorimetry and miscellaneous thermal methods of analysis. Particular emphasis on the evaluation of thermodynamic data obtained from these techniques and its application to the solution of analytical problems. (Lec. 3) *Prerequisite: CHM 431.* Staff

F 516 Ion Exchange and Gas Chromatography II, 3

Principles of ion exchange separations including equilibria, kinetics, column operation and applications of ion exchangers. Principles of gas chromatography including theory of column efficiency, equipment design, column selection, qualitative and quantitative calibration. (Lec. 2, Lab. 3) *Prerequisite:* CHM 432. Rosie and Fasching

F 518 Radiochemistry II, 3

Theory and principles of nuclear science as applied to the various fields of chemistry. Radioactivity, radiation detection and measurement, preparation and separation of radionuclides, emphasis on solution of chemical and environmental research problems with the techniques of nuclear chemistry. (Lec. 3) *Prerequisite:* CHM 432, PHY 214 or permission of instructor. Fasching

5 520 Radiochemistry Laboratory II, 1

Laboratory studies of the theory and principles of nuclear science as applied to various fields of chemistry. Radioactivity, radiation detection and measurement, preparation and separation of radionuclides, instrumental neutron activation analysis, fission process, and uses of radioactive tracers. (Lab. 3) *Prerequisite:* CHM 518 concurrently, CHM 432 and PHY 214, or permission of instructor. Fasching

F 521 (421) Advanced Organic Chemistry I I, 3

Emphasis on fundamental organic structure theory and reaction mechanisms. (Lec. 3) *Prerequisite:* CHM 228 and 230. Vittimberga

5 522 Advanced Organic Chemistry II II, 3

Modern synthetic reactions and their applicability to such areas as natural products and heterocyclic chemistry. (Lec. 3) *Prerequisite:* CHM 421 or permission of instructor. Abell

F 528 Organo-inorganic Chemistry II, 3

Interaction of organic and inorganic molecules. Uniqueness of carbon and the effects that inorganic moieties have on bonded organic fragments described. Organometallic chemistry, the transition metal chelate complexes and carbon in combination with the representative elements considered. Model biochemical systems analyzed. (Lec. 3) *Prerequisite:* CHM 401 and 421 or equivalent. Rosen

F 529 Advanced Physical Chemistry I I, 3

Introduction to modern chemistry with emphasis on quantum chemistry and statistical thermodynamics. Includes development of quantum theory, applications of quantum theory, development and application of statistical distribution functions. (Lec. 3) *Prerequisite:* CHM 432 or permission of instructor. Staff

5 531 Chemical Kinetics I, 3

Topics include transition state theory, unimolecular decompositions, kinetics of fast reactions, reactions in molecular beams, shock waves, theoretical studies of potential energy surfaces and kinetic isotope effects.

(Lec. 3) *Prerequisite:* CHM 634 or permission of instructor. In alternate years, next offered 1973-74. Gonzalez and Brown

5 532 Advanced Physical Chemistry II II, 3

Principles and applications of classical physical chemistry. Includes the three laws of thermodynamics, thermochemistry, phase equilibria, kinetic rate laws, and mechanisms of gas phase reactions. (Lec. 3) *Prerequisite:* CHM 432 or permission of instructor. Staff

F 535 Chemical Applications of Group Theory I, 2

Fundamental principles of group theory will be developed insofar as they are used in simplifying problems of a chemical nature. Group theoretical approach to several typical problems such as hybrid orbitals, molecular orbitals, and molecular vibrations. (Lec. 2) *Prerequisite:* CHM 432. Brown

5 536 Molecular Spectroscopy and Structure II, 3

Theory of molecular dynamics and the interaction of electromagnetic radiation with matter. Absorption and emission spectra in the infrared, far-infrared, and microwave regions will be considered along with Raman scattering in the visible region. Use of spectral results in determining physical properties and elucidating molecular structures will be emphasized. (Lec. 3) *Prerequisite:* CHM 535 or permission of instructor. Brown

new 544 (434) Applications of Chemical Data Processing II, 3

Chemical calculations considered in detail followed by individual program construction and execution. Includes inter-atomic repulsions, dipole moments, interaction of bond orbitals, filling ORD curves, calculation of spectra and quantum mechanical approximations. (Lec. 2, Lab. 3) *Prerequisite:* CHM 222, 332 and a one-semester course in FORTRAN programming or equivalent experience. In alternate years, next offered 1974-75. MacKenzie

F 551, 552 (651, 652) Non-thesis Master's Research I and II, 3 each

Research on original problem for fulfillment of research requirement of non-thesis master's degree. Literature survey, laboratory work and detailed report required. (Lab. 9) *Prerequisite:* permission of department.

5 599 Masters Thesis Research I and II

Number of credits is determined each semester in consultation with the major professor or program committee. A minimum of six credits is required of students who have chosen the thesis option for the master's degree.

5 602 The Transition Metals II, 3

Structure, bonding and reaction mechanisms of transition metals and their compounds. Applications of Ligand field theory. (Lec. 3) *Prerequisite:* CHM 401. Nelson

- 604 Semiempirical Molecular Orbital Theory** *I or II, 2*
Description of semiempirical molecular orbital calculations and applications to problems of current interest. Use of the computer will be emphasized. (Lec. 2) *Prerequisite: permission of instructor. In alternate years.* Petersen

606 Light Scattering, Applications to Research *I or II, 2*
Thermodynamical and quantum mechanical treatment of radiation scattering from pure liquids and solutions. Emphasis on the application related to molecular structural analysis. (Lec. 2) *Prerequisite: permission of instructor. In alternate years, next offered 1973-74.* Nelson

- 621 Carbanion Theory** *I, 3*
Modern theories of organic chemistry pertaining to carbanion reactions such as hydrogen transfer, displacement, additions to multiple bonds, eliminations, and condensations. (Lec. 3) *Prerequisite: CHM 522 or permission of instructor. In alternate years.* MacKenzie

- 623 Free Radical Reactions** *I, 3*
Bond homolysis, polymerization, oxidation processes, rearrangements and use of radical intermediates in synthesis. (Lec. 3) *Prerequisite: CHM 228 and 432. In alternate years.* Abell

- 624 Organic Photochemistry** *II, 3*
Theory and mechanisms of organic photochemistry. Excitation, intersystem crossings and photosensitization will be discussed. Essentials of the interaction of light with matter will be reviewed, including selection rules, group theory, the Franck-Condon principle. Mechanisms of reaction and rearrangement are emphasized. (Lec. 3) *CHM 535 is recommended. In alternate years.* Vittimberga

- 625 Advanced Theoretical Chemistry** *I, 3*
Theoretical approach to electron interaction in organic molecules. Quantum mechanics and bond orbital theories. (Lec. 3) *Prerequisite: CHM 421.* Vittimberga

- 634 Advanced Chemical Thermodynamics** *II, 3*
Statistical thermodynamics is developed and applied to the calculation of thermodynamic properties. (Lec. 3) *Prerequisite: CHM 533 or permission of department. In alternate years, next offered 1973-74.* Kraus

- 638 Advanced Quantum Chemistry** *II, 3*
Includes perturbation theory, the variational principle, time dependent perturbation theory, the helium atom, the hydrogen molecule, Hartree Fock calculations, pi electron systems and the development of the Huckel molecular orbital methods. (Lec. 3) *Prerequisite: CHM 529 or equivalent.* Gonzalez

- 639 Surface Chemistry** *I, 3*
Emphasis on contact catalysis. Topics include physical and chemical adsorption, measurement of surface

areas, heterogeneous kinetics, physical methods for studying absorbed molecules and the mechanisms of selected catalytic reactions. (Lec. 3) *Prerequisite: CHM 432 and MTH 244.* Gonzalez

- 641, 642, 643, 644 Graduate Seminar** *I and II, 1 each*
Results of detailed literature surveys are presented orally and in writing. Required for candidates for advanced degrees in chemistry. (Lec. 1) *S/U credit.* Staff

- 699 Doctoral Dissertation Research** *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

CHILD DEVELOPMENT AND FAMILY RELATIONS (CDF)

400 Child Development: Advanced Course *I, 3*

403 Human Development during Adulthood *I or II, 2-3*

450 Family Interaction *I, 3*

460 Family Life Education *II, 3*

480 Children and Families in Poverty *I or II, 3*

497, 498 Special Problems *I and II, 2-4 each*

- 500 Child Development Seminar** *I or II, 3*
Intensive study of selected topics, such as development of cognitive processes, individual and group differences in the development of language, hereditary factors in physical growth. Review papers prepared by students presented to the class. (Lec. 3) *Prerequisite: CDF 400 or permission of department.* Staff

- 550 Family Relations Seminar** *II, 3*
Intensive study of selected topics, such as maternal deprivation, child rearing practices and attitudes, homogamy and complementary needs in marital choice. Review papers prepared by students presented to the class. (Lec. 3) *Prerequisite: CDF 355 or permission of department.* Staff

- 570 Field Experience with Exceptional Children** *I and II, 3*
Interdisciplinary seminar and laboratory with observation and supervised projects with exceptional children. Concerned with psychological, physical and social factors pertinent to teaching in child development centers. (Lec. 1, Lab. 4) *Prerequisite: CDF 370 or equivalent and permission of department.* Staff

- 595 (595, 596) Master Project: Action Research** *I and II, 1-6*
Number of credits is determined each semester in consultation with the major professor. A minimum of

six credits is required of students who have chosen the action-thesis option for the master's degree. One to six credits may be taken. *S/U credit.*

597, 598 **Advanced Study** *I and II, 3 each*
Survey of important research contributions significant to understanding of human development and relationships. (Lec. 3) Staff

599 **Masters Thesis Research** *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee. Minimum of six credits is required of students who have chosen the thesis option for the master's degree.

CIVIL AND ENVIRONMENTAL ENGINEERING (CVE)

442 **Traffic Engineering** *I, 3*

447 **Highway Engineering** *II, 3*

453 **Computer Analysis of Structures** *II, 3*

472 **Industrial Air Pollution** *I or II, 3*

473 **Analysis of Air Pollutants** *I or II, 3*

478 **Solid Waste Disposal and Management** *II, 3*

481 **Soil Behavior** *I, 3*

482 **Soil Engineering** *II, 3*

483 **Foundation Engineering** *I or II, 3*

491, 492 **Special Problems** *I and II, 1-6 each*

521 **Advanced Strength of Materials** *I or II, 3*
Relations between stresses at a point on different planes passing through the point. Stress concentrations and localized stress. Introduction to the analysis of statically indeterminate stresses in which methods involving elastic strain energy are used. Consideration of the plastic analysis of structures. (Lec. 3) Staff

524 (or OCE 524) **Marine Structural Design** *I or II, 3*
Includes the design of marine structures, consideration of marine construction materials, waterfront structures, ocean towers and underwater structures. (Lec. 2, Lab. 3) Prerequisite: CVE 351. McEwen

551 **Advanced Structural Analysis** *I or II, 3*
Deflections of planar structures using energy concepts and elastic curve principles. Analysis of indeterminate planar structures using advanced techniques. Flexibility and stiffness matrices. (Lec. 3) Prerequisite: permission of department. Staff

565 **Response of Structures to Dynamic Loads** *I or II, 3*
Behavior of materials and components in civil engineering structures. Numerical and exact methods ap-

plied to response in the elastic and inelastic range. Matrix analysis. (Lec. 3) Prerequisite: permission of department. Staff

570 **Sanitary Chemistry** *I, 3*
Application of analytical chemistry to analysis of natural waters; physical chemistry and organic chemistry of aqueous media; chemical principles applicable to operations of sanitary engineering. (Lec. 3) Prerequisite: permission of instructor. Sussman

571 **Sanitary Chemistry Laboratory** *II, 3*
Applications of chemical laboratory procedures to control of water and waste water treatment processes. (Lec. 2, Lab. 3) Prerequisite: CVE 570. Sussman

572 **Biosystems in Sanitary Engineering** *I or II, 3*
Study of the microorganisms which constitute the biological systems in water pollution, water purification and waste water treatment. Application of principles of microbiology and biochemistry to analysis and design in the fields of sanitary engineering and water resources. (Lec. 2, Lab. 3) Prerequisite: permission of instructor. Poon

575 **Open Channel Hydraulics** *I or II, 3*
Analysis of uniform, critical, varied flow, and unsteady flow in open channels. Principles will be applied to open channel design. (Lec. 3) Prerequisite: MCE 354. Poon

584 **Principles of Pavement Design** *I or II, 3*
Design of flexible and rigid type pavements. Design and control of concrete paving mixes, bituminous concrete paving mixes and current research on pavement design. Emphasis on soil engineering including stabilization, moisture movement and frost considerations. (Lec. 2, Lab. 3) Prerequisite: CVE 380 and permission of instructor. Moulthrop and Nacci

585 **Soil Stabilization** *I or II, 3*
Factors that affect soil stability. Mechanisms of soil stabilization. Design and analysis of stabilized soils. (Lec. 2, Lab. 3) Prerequisite: CVE 380 and permission of instructor. Staff

586 **Physio-chemical Properties of Soils** *I, 3*
Influence of physio-chemical properties of soils on engineering characteristics and performance. Application of mineralogy, ion exchange and colloidal theory; effect of marine environment; and the nature of soil water. Prerequisite: CVE 481 or permission of instructor. Staff

587 **Ground Water Flow and Seepage Pressures** *I, 3*
Hydrodynamics of fluid flow through porous media. Analytical methods for steady and unsteady seepage in aquifers; theoretical analysis with practical modification of seepage problems involving foundations, drainage structures, earth dams and wells. (Lec. 2, Lab. 3) Prerequisite: CVE 380 and permission of instructor. Nacci and Wang

- 596 Numerical Methods in Structural Engineering** *I or II, 3*
 Methods of successive approximations and numerical procedures in the solution of stress, vibration and stability problems in structural members. Nonuniform members, elastic supports, plates, torsion. (Lec. 3) *Prerequisite: permission of department. Staff*
- 599 Masters Thesis Research** *I and II*
 Number of credits is determined each semester in consultation with the major professor or program committee.
- 601, 602 Graduate Seminar** *I and II, 1 each*
 Discussions and presentation of papers based on research or detailed literature surveys. (Lec. 1) *Required of all students in graduate residence, but a maximum of 1 credit per year is allowed and no more than 2 credits are allowed for the entire period of residence. Staff*
- 650 Advanced Structural Analysis** *I or II, 3*
 Continuation of CVE 551. Analysis of indeterminate trusses, structures with nonprismatic members, and shell and folded plate structures. Investigation of secondary stresses. (Lec. 3) *Prerequisite: permission of department. Staff*
- 651 Plate Structures** *I or II, 3*
 Fundamental theories of bending and buckling of plates with practical application to the design of structural plate components of metal and reinforced concrete. (Lec. 3) *Prerequisite: permission of instructor. Staff*
- 652 Shell Structures** *I or II, 3*
 Membrane and bending theories of thin shells and their practical application to the design of shell and folded-plate structures of metal and reinforced concrete. (Lec. 3) *Prerequisite: CVE 651 or permission of instructor. Staff*
- 653 Analysis of Space Structures** *I or II, 3*
 Analysis of three-dimensional determinate and indeterminate beams, frames, and trusses, by matrix methods. Deflections and indeterminate analysis using virtual work, conjugate structure, and slope deflection procedures. Emphasis is on numerical solutions using the University's digital computer. (Lec. 3) *Prerequisite: CVE 396, 551. Lavelle*
- 655 Matrix Methods in Structural Analysis** *I or II, 3*
 Development of finite-element methods of structural analysis. Application to stress problems and to plate and shell structures. (Lec. 3) *Prerequisite: permission of instructor. Staff*
- 673 Theory of Water Purification and Treatment** *I, 3*
 Principles of modern water purification and engineering practices. Aeration, deodorization, sterilization, coagulation, filtration, water softening, iron removal, disinfection and corrosion control. (Lec. 3) *Campbell*
- 674 Sanitary Engineering Laboratory** *I or II, 3*
 Advanced phases of sewage treatment and purification including sludge digestion, sludge gas analysis, biochemical oxygen demand, conditioning of sludge, activated sludge, sewage trickling filters and chemical precipitation. (Lec. 2, Lab. 3) *Prerequisite: CVE 679. Poon*
- 675 Sanitary Engineering Design** *I or II, 3*
 Functional design of modern water treatment plant providing treatment of water for domestic and industrial consumption. (Lec. 1, Lab. 6) *Prerequisite: CVE 679. Poon*
- 676 Sanitary Engineering Design** *I or II, 3*
 Functional design of modern sewage treatment works providing treatment of sewage. (Lec. 1, Lab. 6) *Prerequisite: CVE 673. Campbell*
- 677 Stream and Estuarine Analysis** *I or II, 3*
 Functionals and mathematical concepts of physical and biological factors applied to the evaluation of the pollution capacity of streams and estuaries. (Lec. 3) *Prerequisite: MTH 244. Campbell*
- 678 Industrial Waste Water Treatment** *I or II, 3*
 Advanced considerations of industrial waste disposal problems of major waste producing industries, including the study of waste producing processes, composition of waste waters, treatment methods, and in-plant abatement techniques. (Lec. 3) *Prerequisite: permission of instructor. Poon and Sussman*
- 679 Treatment of Municipal Wastes** *I or II, 3*
 Theory and mathematical concepts of physical, chemical, and biological oxidation processes applied to the clarification and purification of municipal waste waters. (Lec. 3) *Prerequisite: permission of instructor. Poon*
- 681 Advanced Soil Mechanics** *I, 3*
 Index properties and physical properties of soils. Laboratory and field procedures for soil identification. Permeability and flow of water through soils. Compressibility characteristics of soils and consolidation theories as applied to settlement analysis. (Lec. 2, Lab. 3) *Prerequisite: CVE 521 or equivalent. Nacci or Wang*
- 682 Advanced Soil Mechanics** *II, 3*
 Stress analysis. Elastic theory of stress distribution in soils. Application of consolidation theory. Shearing phenomena in soils with application to bearing capacity, earth pressure and slope stability. Pile foundation analysis. Special topics. (Lec. 3) *Prerequisite: CVE 681. Nacci or Wang*
- 691, 692 Special Problems** *I and II, 1-6 each*
 Advanced work, under the supervision of a member of the staff and arranged to suit the individual requirements of the student. (Lec. or Lab. according to nature of problems. Credits not to exceed a total of 12.) *Prerequisite: permission of department. Staff*

F92

696 Numerical Methods in Structural Engineering II, 3

Continuation of CVE 596. Applications of relaxation, finite differences, ordinary and partial differential equations to blast loads on structures, bending of plates, and buckling of beams. (Lec. 3) *Prerequisite:* CVE 596 or permission of instructor. Staff

699 Doctoral Dissertation Research I and II
Number of credits is determined each semester in consultation with the major professor or program committee.

COMMUNITY PLANNING (CPL)

410 Fundamentals of Urban Planning II, 3

503 Urban Planning and Politics in the Metropolis I, 3
Significance and impact of urban planning on growth and betterment of cities and metropolitan areas. The planning process as it relates to the formulation of community development policies and the institutional framework from which they are produced. (Lec. 3) *Prerequisite:* PSC 422 or 460, or equivalent. Foster

505 Values and Prediction in Planning I, 3
Examines human needs and wants, and how decisions are influenced by society and nature. Provides a framework for the measurement and analysis of qualitative data, and for the prediction of human behavior relative to planning. (Lec. 3) Jeffrey

511 Introduction to Community Planning History and Theory I, 3
The development of community planning in the U.S. History of governmental planning and evolution of the planning profession. Theoretical elements and constructs basic to contemporary planning practice. (Lec. 3) Foster

532 (or REN 532) Land Resource Economics II, 3
The study of the economic relationship of man and the scarce natural and man-made resources on which life depends. Supply and demand concepts, rent theory, the economics of resource conservation and the impact of public policy and law on resource use are considered. (Lec. 3) Mahayni

551, 552 Problems in Planning Practice I and II, 3 each
Individual research, study, and reporting on a phase of planning practice to be chosen in consultation with instructor. Familiarizes students with the field operation of planning and introduces them to the practical difficulties of research, community involvement, and final reporting. Problems of planning with inner-city communities. (Lab. 6) *Prerequisite:* permission of instructor. Johnson

599 Masters Thesis Research I and II
Number of credits is determined each semester in consultation with the major professor or program committee.

603, 604 Seminar in Contemporary U.S. Environment I and II, 8 each

Comprehensive survey of structural change in American society and its environmental settings, as well as the universal perspectives in terms of which technical planning skills must be developed and employed. (Lec. 6, Tut. 2) Staff

613 Interdisciplinary Planning Workshop I I, 4
Integrative public policy and problem oriented course. Introduces methods of the management and regional sciences and community field work to generate comprehensive and single purpose plans. Lectures, workshops and field work. (Lec. 2, Lab. 4) Downe

614 Interdisciplinary Planning Workshop II II, 4
Continuation of Planning Workshop I. Design of plans and programs for defined social settings. Consideration of plan implementation factors. Lectures, workshops, field work. (Lec. 2, Lab. 4) Downe

623 Problems in Planning and Environment I, 6
Application of various planning methods to specific problem areas on local and regional levels. Develop solutions integrating physical, social and economic objectives to relate natural and man-made environment to neighborhood and large area development. (Lec. 3, Lab. 6) Hammerschlag

631 Planning Law Seminar I, 3
General review and discussion of legal principles and thought concerned with property rights, political power, and the legal aspects pertinent to the planning and development of public and private activities. (Lec. 3) Brooks

633 Advocacy Planning I or II, 3
Relationships between residents of an urban slum and public officials in governmental agencies; "citizen participation" in urban renewal areas, enforcement of housing laws, selected problems of city schools, public assistance, and civil disobedience. Relationships in each of these areas will be reviewed on the basis of statutory, administrative, or contractual material. (Lec. 3)

634 Seminar in Professional Planning Practice II, 3
Current planning operations in public and private organizations, staff and client relations, ethical responsibilities, interdisciplinary cooperation; new trends, legislation and planning opportunities on local, state and national levels. (Lec. 3) Barber

636 Planning Seminar in Urban Design I, 3
Significant concepts of historical and contemporary urban form ranging in scale from the city as a whole to architectural detail of public projects. Use of slides and films to illustrate the visual impact and importance of excellence in design. (Lec. 3) Hammerschlag

642 Research Methodology II, 3
A basic foundation for independent research directed toward the production of a thesis at the master's de-

gree level. Basic concepts of problem definition, formulation and testing of hypotheses, and the relation of research to theoretical concepts. (Lec. 3) Brooks

644 Environmental Impact Planning *I or II, 3*
Development of plans and projects analyzed through the relationships with the surrounding natural and man-made elements. Studies existing ecology, potential and contrasting settlement patterns and community life. Governmental environment policies, interdisciplinary teams and the potential new role of universities in environmental affairs. (Lec. 3) Staff

646 Planning the Delivery of Community Health Services *I or II, 3*
An introduction to planning for the delivery of health care services relating to other sectors of society. Subject areas include target populations (e.g. poor, elderly), payment for services, types of facilities and personnel distribution of demands, and methods for collecting, organizing, and overlapping health data. (Lec. 3) Staff

651, 652 Planning Seminar *I and II, 3 each*
Group and/or individual investigation of special problems in city and regional planning. Staff

661 Seminar in Planning Theory *I, 3*
Critical survey of current theories and contemporary planning concepts. The logic of the process of city and regional planning, its basic axioms and postulates, focusing on such elements as value, fact, opinion, bias, goal, symbol, dogma, and intuition. Models for choice-making and resource-allocation as contributions to systematic planning theory. (Lec. 3) Staff

672 Plan Implementation *I or II, 3*
Survey of the tools of plan implementation, including public tools such as zoning, subdivision control, capital budgets, renewal, taxation, other federal and state programs, and private tools such as mortgaging and easements. Readings, discussion, and special problems in the application of the tools. (Lec. 3) Prerequisite: CPL 631. Brooks

691, 692 Special Problems *I and II, 1-6 each*
Advanced work, under the supervision of a member of the staff and arranged to suit the individual requirements of the student. Prerequisite: permission of instructor. Staff

COMPUTER SCIENCE (CSC)

410 Introduction to Computer Science and Algorithmic Processes *I and II, 3*

411 Computer Organization and Programming *I and II, 3*

412 Programming Systems *II, 3*

413 Data Structures *I, 3*

491, 492 Problems in Computer Science *I and II, 3 each*

500 Scientific Applications of Digital Computers I *I, 3*
Algorithms, techniques, and practical procedures for digital computers related to well-known applications of numerical methods. Approximation methods, numerical quadrature, solution of differential equations, zeros of functions, error analysis. Examples, using the University computer. (Lec. 3) Prerequisite: MTH 243, CSC 410 and permission of instructor. Carrano

502 Theory of Algorithmic Languages and Compilers *II, 3*
Formal description of procedure-oriented languages and the techniques used in translating algorithms written in these languages into computer programs. (Lec. 3) Prerequisite: credit or concurrent registration in CSC 413. Bass

505 Design of Digital Circuits
See Electrical Engineering 505.

512 Advanced Programming Systems *I, 3*
Advanced analysis of monitor and executive systems. Several topics from CSC 412 will be studied in greater depth, along with recent developments in the field. (Lec. 3) Prerequisite: CSC 412 and 413. Bass and Tetreault

515 Theory of Computation *I, 3*
Turing machines, recursive functions, Shephardson-Sturgis machines, Universal Turing machines, Church's thesis, standard indexing, decision and halting problems, recursive sets, recursively enumerable sets, automata, computational complexity, Post productions. (Lec. 3) Prerequisite: CSC 410 and permission of instructor. Bass

525 (or IDE 525) Simulation *II, 3*
Introduction to simulation. Discrete simulation models. Comparison of discrete change simulation languages. Simulation methodology including generation of random variates, design of simulation experiments for optimization, analysis of generated data, and validation of models and results. Selected applications of simulation. Prerequisite: CSC 410 and 6 credits in statistics. In alternate years, next offered 1973-74. Carney

535 Information Organization and Retrieval *II, 3*
Construction and accessing of large data bases; document classification, retrieval, and evaluation techniques; automatic dictionary and thesaurus construction; natural language content analysis; question answering systems. (Lec. 3) Prerequisite: CSC 413. Weideman

551 Scientific Applications of Digital Computers II *II, 3*
Algorithms, techniques and practical procedures for digital computers emphasizing linear computations and statistical applications. Monte Carlo methods.

Matrix calculations, simultaneous linear equations, matrix inversion. Least square analysis, multiple regression. Characteristic value problems. (Lec. 3) *Prerequisite: MTH 215 and CSC 410 or equivalent and permission of instructor.* Hemmerle

581 (or ELE 581) Intelligence in Machines and Humans *I or II, 3*
Information processing schemes which exhibit "intelligence." Formal theories of human information processing. Pattern recognition, problem-solving methods, semantic information processing, coordination, and computer-controlled manipulators. (Lec. 3) *Prerequisite: basic knowledge of probability and digital logic or permission of instructor.* Birk

591, 592 Problems in Computer Science *I and II, 1-3 each*
Advanced work in computer science. Courses will be conducted as seminars or as supervised individual projects. (Lec. or Lab. arranged) Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

ECONOMICS (ECN)

401 Poverty in the United States *I or II, 3*

402 Urban Economics *I or II, 3*

438 International Trade and Policy *I or II, 3*

464 Comparative Economic Systems *I or II, 3*

503 Development of the United States Economy *I, 3*
The process of economic development, as illustrated by the economy of the United States. (Lec. 3) *Prerequisite: ECN 126, and either HIS 141, 142 or ECN 302, or permission of instructor.* Haller

512 History of Economic Analysis *II, 3*
Advanced work which examines formative developments in economic thought from classical political economy to modern welfare economics. Emphasis on relationships between doctrines and their institutional setting. (Lec. 3) *Prerequisite: permission of instructor.* Schurman

515, 516 Economic Research *I and II, 3 each*
Independent research. *S/U credit.* Staff

527 Macroeconomic Theory *I, 3*
Economic relationship expressed using analytical concepts. Static and dynamic models of aggregate economic behavior developed and analyzed. (Lec. 3) *Prerequisite: ECN 327 and 375 or equivalent, or permission of instructor.* Hume

528 Microeconomic Theory *I, 3*
Analytic tools of optimization, Neoclassical price and distribution theory. Linear programming and produc-

tion theory. General equilibrium and welfare economics. (Lec. 3) *Prerequisite: ECN 328 and 375 or equivalent, or permission of instructor.* Rayack

532 Industrial Organization and Public Policy *II, 3*
Theoretical and empirical analysis of the structure of industrial markets; the behavior and performance of business firms in the American economy; the government-business relationship and its effect on the formulation of public economic policy. (Lec. 3) *Prerequisite: ECN 337 or permission of instructor.* Dirlam

538 International Economics: Theory and Policy *I or II, 3*
Theory of international trade and applications to current problems. (Lec. 3) *Prerequisite: ECN 327 and 328 or permission of instructor.* Suzawa

539 Welfare Economics *I or II, 3*
Welfare criteria; conditions of optimality; causes of non-optimality and implied correctives; alternative social decision-making techniques. (Lec. 3) *Prerequisite: ECN 327 and 328 or permission of instructor.* Hume

543 Public Finance and Fiscal Policy *I, 3*
Analysis of private wants and public needs and the economic share of each serves as an introduction to a searching examination of such selected federal and federal-state fiscal problems as budgetary theory and procedures, tax theory and reform, debt and debt management policy. (Lec. 3) *Prerequisite: ECN 342 or permission of instructor.* Starkey

552 Monetary Theory and Policy *II, 3*
Analysis of structure and functioning of monetary and banking systems; discussion of contemporary monetary theories; evaluation of monetary policies. (Lec. 3) *Prerequisite: ECN 334 or permission of instructor.* Barnett

566 Economic Planning and Public Policy in Developing Nations *II, 3*
Resource and financial planning in public and private sectors of developing nations with emphasis on planning tools, allocation of domestic and foreign resources, and on national economic policies. (Lec. 3) *Prerequisite: ECN 327 and 363 or 464, or equivalent, or permission of instructor.* Suzawa

575 Introduction to Mathematical Economics *I or II, 3*
Application of quantitative methods to economic problems, such as general equilibrium theory, optimal growth and stabilization models. (Lec. 3) *Prerequisite: ECN 375, 327 and 328 or permission of instructor.* Hume

576 Econometrics I *II, 3*
Application of statistics and mathematics to economic analysis. Implications of assumptions required by statistical methods for testing economic hypotheses will be fully explored. Current research applications of

econometric methods will be examined and discussed. (Lec. 3) *Prerequisite: ECN 126 or 376 and 6 credit hours of statistics, or permission of instructor.* Ramsey

- 5 577 **Econometrics II** II, 3
 72 Continuation of Econometrics I. (Lec. 3) *Prerequisite: ECN 576 or permission of instructor.* Lampe

- 5 595 **Problems of Modernization in Developing Nations**
 See Resource Economics 595.

- 5 599 **Masters Thesis Research** I and II
 73 Number of credits is determined each semester in consultation with the major professor or program committee.

- 5 627 **Advanced Macroeconomic Theory** II, 3
 Post-Keynesian macroeconomic theory, growth and cyclical models, current development in national income analysis. (Lec. 3) *Prerequisite: ECN 527 and 528 or permission of instructor.* Hume

- 5 628 **Advanced Microeconomic Theory** II, 3
 Neoclassical value and distribution theory. Theories of imperfect competition, general equilibrium theory and dynamic analysis. (Lec. 3) *Prerequisite: ECN 527 and 528 or permission of instructor.* Ramsey

- 5 690 **National Income** II, 3
 Advanced macroeconomic theory. (Lec. 3) *Prerequisite: ECN 126 or 990 or permission of instructor.* Hellman

- 5 699 **Doctoral Dissertation Research** I and II
 72 Number of credits is determined each semester in consultation with the major professor or program committee.

- 5 990 **Principles of Economics** I and II, 3
 73 Survey of micro- and macroeconomic theory. (Lec. 3) *Graduate credit for matriculated M.B.A. students only.* Hellman

EDUCATION (EDC)

- 401 **Development and Utilization of Instructional Materials** I and II, 3

- 403 **History of Education** I, 3

- 407 **Philosophy of Education** II, 3

- 409 **Health Aspects of Aging** I and II, 3

- 410, 411 **Seminar and Supervised Field Practicum in Education of the Aging** I and II, 3 each

- 424 **Teaching and Reading** I and II, 3

- 450 **Introduction to Guidance** I and II, 3

- 478, 479 **Problems in Education** I and II, 1-3 each

- 490 **Home Economics Education Grades 1 through 6** I and II, 2

- 491 **Home Economics Education Teaching Adults** I and II, 2

- 5 503 **Education in Contemporary Society** I and II, 3
 5 Analysis of contemporary social and economic characteristics of society that affect education. Evaluation of school as a social institution, with emphasis on the role education plays in progressive development of democratic society. (Lec. 3) Hagey

- 5 504 **Adult Basic Education** I and II, 3
 Teaching of adults whose educational level is below high school completion. Physical, social and psychological characteristics of disadvantaged adults and various techniques and materials that are useful in motivating and teaching them will be studied. (Lec. 3) *Prerequisite: permission of instructor.* McCreight and Staff

- 5 505 **Principles and Practices of Leadership Development for Youth and Adult Programs** I or II, 3
 51 Philosophy and interrelationships of vocational-technical and general education with extension education and other community educational agencies; leadership concepts and implications; methods and techniques for increasing the effectiveness of organizations. (Lec. 3) *Prerequisite: permission of instructor.* McCreight

- 5 506 **Methods of Teaching Home Economics** I or II, 3
 72 Selection, organization and use of instructional materials, methods and techniques of teaching home economics. (Lec. 3) P. Kelly

- 5 507 **Curriculum Study in Home Economics** I or II, 3
 Developing a philosophy and acquiring findings about students, school programs, communities, and current trends as a basis for constructing a scope and sequence plan for a homemaking program. Units of work developed for various age groups. (Lec. 3) P. Kelly, May, MacKenzie

- 5 508 **Supervision of Home Economics** I or II, 3
 Primarily for homemaking teachers who wish to become supervising teachers and work with college student teachers majoring in home economics teacher education. (Lec. 3) P. Kelly, MacKenzie

- 5 509 **Seminar in Home Economics Education** I or II, 3
 73 Critical study of research literature and research techniques appropriate to solution of problems in home economics. (Lec. 1-3) Cusack, P. Kelly

- 5 510 **Practicum in Incorporating Televised Media** I, 3
 Enables students to develop skills in scripting and producing educational television programs. Application of knowledge of directing video tapes will be employed. (Lec. 1, Lab. 4) *Prerequisite: EDC 401 or permission of department.* Hicks

F12

511 Evaluation of Film and Recorded Material I, 3
Theory and principles of basic educational film processes. History of educational motion pictures, social and cultural implications of film, and standards for its evaluation and use in the schools. (Lec. 1, Lab. 4) *Prerequisite: EDC 401 or permission of department.* Howard

new 73-74

512 Organization and Administration of Audiovisual Programs II, 3
Organization and administration of media departments in public schools. Media design and logistics, facility design, finance and organization. Planning in-service training programs. (Lec. 2, Lab. 2) *Prerequisite: EDC 401 or permission of department.* Cresser

new 73-74

513 Research and Theory in Instructional Technology II, 3
Research methodology in the field of media as it applies to education. Research designs including survey, descriptive and experimental types evaluated. (Lec. 2, Lab. 2) *Prerequisite: EDC 401 or permission of department.* Howard

514 Current Trends in Elementary Education I, 3
For teachers and administrators, the most effective use of instructional materials, media of communication, and personnel in elementary school. (Lec. 3) *Prerequisite: EDC 529 or permission of department.* In alternate years, next offered 1973-74. Nally

520 Teaching of Arithmetic I, 3
Designed for the experienced teacher, examination of the principles underlying the teaching of arithmetic in the elementary school, together with the comprehensive survey of materials and methods available for the classroom teacher of arithmetic. (Lec. 3) *Prerequisite: senior or graduate standing. In alternate years, next offered 1974-75.* Nally

523 Physical Factors Related to Reading Disability I, 3
Investigation and evaluation of various physical factors contributing to reading disability, such as visual, hearing, and speech deficiencies, motor adjustments, glandular deficiencies, general health, brain damage and congenital word-blindness, and lateral dominance. Screening tests and instructional procedures for use in various areas. (Lec. 3) *Prerequisite: EDC 561 and permission of instructor.* In alternate years, next offered 1973-74. Staff

526 Teaching the New Grammars I, 3
Implications of the newer grammars for the teaching of English, including a review of the history of grammar, traditional grammar, and as needed, the linguistic theory necessary to an understanding of the newer grammars. (Lec. 3) *Prerequisite: graduate standing and/or certification to teach English.* DiBiasio

528 Teaching Language Arts II, 3
Phonics, grammar, lexicography, and usage in American English for the elementary school classroom

teacher. Presentation, use, evaluation, and development of methods and materials for students in the classroom. (Lec. 3) In alternate years, next offered 1974-75. Nagel

529 Foundations of Educational Research I and II, 3
Analysis of the current major research approaches to educational problems with emphasis on interpreting published research involving the language of statistics. Functional skills in basic descriptive statistics needed prior to enrolling. (Lec. 3) MacMillan and Purnell

531 (or FNS 531) Teaching of Nutrition I or II, 3
Development of curriculums in nutrition education for teachers in grades K through 12 and appropriate programs for community nutrition educators. Emphasis on innovative teaching techniques using latest nutrition knowledge. (Lec. 3) *Prerequisite: graduate standing and permission of department.* Dymsha and MacKenzie

534 Mathematics in the Secondary School II, 3
Deals with the implementation of a modern mathematics program in the secondary school through a study of modern mathematics concepts, experimental programs, and instructional planning. (Lec. 3) *Prerequisite: 15 credits in mathematics.* Pezzullo

541 Reading in Secondary School Content Subjects I and II, 3
Designed especially to help junior and senior high school teachers to cope with the reading problems in their subject areas. (Lec. 3) *Prerequisite: EDC 313 or permission of department.* Aukerman

550 Vocational Information and Career Development I and II, 3
Classification and description of jobs and industries; study of occupational trends; needs of special groups entering the labor market; vocational development theories and counseling for long-range career planning. (Lec. 3) *Prerequisite: EDC 450 and graduate standing.* Maynard

551 Counseling Techniques I and II, 3
Foundation of the theory and practice, with special emphasis upon approaches to counseling in various educational settings; primarily designed for preparation of school counselors and student personnel educators. (Lec. 3) *Prerequisite: EDC 450 and graduate standing.* Rife

552 Group Procedures in Guidance I and II, 3
Basic principles and techniques in human behavior in groups with emphasis on a fundamental approach in guidance, counseling, and education. How group approaches based on scientific research and study can be applied to guidance and personnel programs with particular reference to articulation and orientation, educational and occupational planning and group counseling. (Lec. 3) *Prerequisite: permission of instructor.* Pascale

- 553 Counseling Practicum** *I and II, 3*
 Advanced course in counseling. Multiple counseling sessions using tapes and supervised observation will be included to help measure individual assessment of growth and competence. (*Lec. 1, Lab. 5*) *Prerequisite: EDC 450, 550, 551, PSY 434, and permission of instructor.* Gunning
- 554 Individual Appraisal in Guidance** *II, 3*
 Nature of the appraisal process and data essential to understanding the educational, vocational and social needs of persons. Emphasis is upon the team approach in pupil personnel services and the use of the case materials. (*Lec. 3*) *Prerequisite: PSY 434 and EDC 551.* Gunning
- 555, 556 Supervised Field Work and Seminar in Guidance and Counseling** *I and II, 3 each*
 Clinically oriented to give students an opportunity in selected school systems to apply and integrate guidance and counseling theories and skills. 200 clock hours of laboratory experience required in addition to the seminar for the total of two semesters' work. (*Lec. 2, Lab. 3*) *Prerequisite: EDC 554 and permission of instructor.* Pascale, Maynard, Rife and Quinn
- 557 Principles and Practices of Student Personnel Services in Higher Education** *I, 3*
 Survey of the historical, psychological, organizational, and educational factors which have evolved and combined to form student personnel work. (*Lec. 3*) *Prerequisite: EDC 553 and 554.* Quinn
- 558 Organization and Administration of Student Personnel Services in Higher Education** *II, 3*
 Systematic analysis of current practices in the alignment and operation of student personnel services, with continuing review of their interrelationships to the total educational program. (*Lec. 3*) *Prerequisite: EDC 553, 554 and 557.* Quinn
- 561 Analysis of Reading Disabilities** *I, 3*
 Causes of reading difficulties and the administration of diagnostic reading tests. Emphasis on construction and use of informal tests and standardized measures. Practice in analyzing data from case histories and in making individual case studies. (*Lec. 3, Lab. 2*) *Prerequisite: EDC 524 and permission of instructor.* McGuire
- 562 Techniques in Remedial Reading** *II, 3*
 Specific practices effective in teaching of remedial reading in both the regular classroom and remedial reading clinics. Analysis of published materials. Methods of building new materials with discussion and demonstration of their practical application. (*Lec. 3, Lab. 2*) *Prerequisite: EDC 561 and permission of instructor.* McGuire
- 563 Reading Programs for the Disadvantaged** *I, 3*
 Impact of the culture of the disadvantaged upon the child and his response to learning and the school, with special emphasis on reading and the adjustment of reading materials and methods to individual socioeconomic-cultural differences. (*Lec. 3*) *Prerequisite: EDC 424 or permission of instructor.* Bumpus
- 564 Beginning Reading Programs** *II, 3*
 Analysis of various approaches to reading instruction (other than the basal method) including phonetic, linguistic, language arts, programmed, and other experimental systems. Currently available materials will be analyzed and classified. (*Lec. 3*) *Prerequisite: EDC 424.* Aukerman
- 565 Analysis and Evaluation of Current Research in Reading** *II, 3*
 Concise analysis of the latest research in reading. Criteria for the evaluation of reading research data as it applies to both teacher and learner. Location and application of current research to reading programs. (*Lec. 3*) *Prerequisite: EDC 424 and permission of instructor.* In alternate years, next offered 1973-74. McGuire
- 566, 567 Practicum in Reading** *I and II, 3 each*
 Supervised case studies, practicum and seminar reports on an individual reading project at either elementary or secondary level. Lecture and/or laboratory. 120 hours plus seminar. *Prerequisite: EDC 562 and permission of instructor.* McGuire
- 570 Elementary School Curriculum** *II, 3*
 Modern curriculum in the elementary school with emphasis on the needs of children. The course covers language, arts, social studies, science, arithmetic and special subjects. (*Lec. 3*) *Prerequisite: EDC 503, 529 or equivalent.* In alternate years, next offered 1973-74. Staff
- 571 The Secondary School Curriculum** *II, 3*
 Intensive study of basic principles and procedures utilized in developing curriculum materials. Emphasis given to content of all curriculum areas in junior and senior high schools. (*Lec. 3*) *Prerequisite: EDC 503, 529.* In alternate years, next offered 1974-75. Whitcomb
- 572 Cooperative Supervision** *I and II, 3*
 Analysis of function, principles and techniques of democratic cooperative supervision of teachers and other school officials. Application of these principles to supervisory problems of principals, heads of departments, special supervisors and critic teachers. (*Lec. 3*) *This course meets certification requirements for Critic Teacher Certificate.* Heisler
- 573 Seminar—Educational Research** *I and II, 1*
 For master's degree candidates developing a thesis. Student presentations of thesis topics, research designs, and research findings. Attention given to the orderly development of research studies. Graduate students who require assistance with their thesis problems must enroll for this course unless they are enrolled for thesis credit. *Prerequisite: registration for thesis.* Staff

5572

574 Current Trends in Secondary Education*I and II, 3*

Effective use of instructional materials, media of communication, and organization of personnel and current research. *Prerequisite: EDC 529, 571 or permission of department.* Staff

575, 576 Supervised Field Study and Seminar in

Elementary or Secondary Education *I and II, 3 each*
Two semester sequence for non-thesis candidates, composed of lectures, seminars and field work. Candidates plan and carry out a field study project approved by the instructor. The completed field study project report must be successfully defended during seminar. *Prerequisite: admission to a master's program in education and permission of instructor.* Kelly

577 Organization and Administration in Elementary School*I, 3*

The functions and duties of elementary school principals. (*Lec. 3*) In alternate years, next offered 1973-74. Nagel

580 Organizing and Administering Youth Programs*I or II, 3*

Planning, organization, instruction and supervision of youth programs. Includes vocational-technical and general education in their relationship to extension education and other community agencies. Youth guidance and psychological development emphasized. (*Lec. 3*) *Prerequisite: EDC 505 or permission of instructor.* McCreight

581 Organizing and Administering Programs of Adult Education*I or II, 3*

Planning, organization, instruction and supervision of continuing education for adults in both vocational-technical and general education as conducted by extension education and other community agencies. (*Lec. 3*) *Prerequisite: EDC 505 or permission of instructor.* McCreight

582 Curriculum Development in Vocational-Technical and Extension Education*I, 3*

Principles and processes involved in the basic concepts affecting vocational-technical and extension education programs. Emphasis is given to planning, execution and evaluation. (*Lec. 3*) *Prerequisite: EDC 580 or 581 or permission of instructor.* McCreight

583 Analyzing Community Needs and Resources for Youth and Adult Programs*I, 3*

Designed to help the student function effectively in the role of change-agent in a community setting. Concepts of goals, change, power and community will be considered in relation to the student's community experiences. (*Lec. 3*) *Prerequisite: permission of instructor.* Bromley

584 The Adult and the Learning Process*I and II, 3*

Examination of the adult as a learner with emphasis on the factors that affect adult learning. (*Lec. 3*) *Prerequisite: EDC 581 or permission of instructor.* Bromley

EXT 72

585 Seminar on Leadership for Youth and Adult Programs*II, 3*

Students will participate in a non-structured group to observe the emergence of leadership and the effects of individual behavior on self and others. (*Lec. 3*) *Prerequisite: open to program majors with permission of instructor.* Bromley

586, 587 Problems in Education*I and II, 3 each*

Advanced work for graduate students in education. Courses conducted as seminars or as supervised individual projects. (*Lec. or Lab.*) *Prerequisite: permission of department.* Staff

588, 589 Supervised Field Practicum and Seminar in Youth and Adult Education*I and II, 3 each*

Designed to provide students an opportunity in selected clinic systems to apply leadership principles and practices. 200 clock hours of practicum are required in addition to the seminar. (*Lec. 2, Lab. 3*) *Prerequisite: EDC 582, 583, or 584 and 529, or permission of instructor.* Bromley, McCreight

EXT 72

590 Social Issues in Urban Education*II, 3*

Current social problems with which teachers are confronted in urban education. Emphasis is placed upon current problems from the perspective of sociology, social welfare, psychology and education. Field trips, visiting lecturers and sensitivity training will all be utilized in the development of issues. (*Lec. 3*) *Prerequisite: EDC 102.* Staff

594 Organization and Supervision of Reading Programs*II, 3*

The various roles of the reading specialist in relation to the other line-staff personnel will be discussed. Problems concerning the orientation of new teachers, reading research and development, inservice programs, and community support will be explored. (*Lec. 3*) *Prerequisite: EDC 562.* In alternate years, next offered 1973-74. Staff

599 Masters Thesis Research*I and II*

Number of credits is determined each semester in consultation with the major professor or program committee.

ELECTRICAL ENGINEERING (ELE)**411 Microwave and Quantum Electronics** *I, 3***413 Microwave and Quantum Electronics Laboratory** *I, 3***417 Direct Energy Conversion** *II, 3***427 Electromechanical Devices and Systems** *I, 3***431 Electrical Engineering Materials I** *I, 3***432 Electrical Engineering Materials II** *II, 3*

- 433 Electrical Engineering Materials Laboratory** *II, 3*
- 436 Communication Systems** *I and II, 3*
- 437 Introduction to Photo-electronic Devices** *I and II, 3*
- 443 Electronics II** *I, 5*
- 444 Electronics III, Pulse and Digital Circuits** *II, 4*
- 457 Feedback Control Systems** *I, 3*
- 458 Systems Laboratory** *II, 3*
- 481, 482 Biomedical Engineering Seminar** *I and II, 1 each*
- 484 Modeling of Physiological Systems** *II, 3*
- 491, 492, 493 Special Problems** *I and II, 1 each*
- 501 Linear Systems Theory** *I, 3*
 Transform analysis of discrete and distributed systems, functions of a complex variable, state variable description of systems and time domain analysis, matrices and linear spaces, feedback concepts. (*Lec. 3*) Staff
- 503 (or MCE 503) Linear Control Systems** *I or II, 3*
 Concepts of controllability and observability, state feedback, quadratic performance indices and optimal linear control, frequency response properties of optimal feedback regulators, observer theory and state reconstruction, state estimation (Kalman-Bucy filter), separation theorem and modern control system design. (*Lec. 3*) *Prerequisite: ELE 501 or equivalent.* Lindgren, Palm
- 505 (or CSC 505) Design of Digital Circuits** *I, 3*
 Analytical development of methods for digital circuit design. Computer arithmetic, control, and memory elements. Design of sequence generators. Special purpose digital circuits for performing numerical operations such as integration, smoothing and filtering. (*Lec. 3*) Tufts
- 506 Digital Signal Processing** *II, 3*
 Digital representations of signals and noise, digital filtering and spectral analysis, design of digital circuits for signal parameter estimation and signal detection. (*Lec. 3*) *Prerequisite: one course from ELE 509, OCE 561, IDE 411, or MTH 451.* Tufts
- 509 Systems with Random Inputs** *I or II, 3*
 Discrete and continuous linear systems with random inputs. Introduction to random processes in the context of linear systems. Applications to detection, smoothing and prediction. (*Lec. 3*) *Prerequisite: knowledge of differential equations, linear systems and transform methods.* Staff
- 511 Electromagnetic Fields** *I, 3*
 Review of electrostatics and magnetostatics. Maxwell's equations, wave propagation in dielectric and conducting media. Boundary phenomena. Radiation from simple structures. Relations between circuit and field theory. (*Lec. 3*) Staff
- 514 Microwave Electronics** *I or II, 3*
 Electronic engineering at microwave frequencies, microwave circuit theory, impedance transformation and matching, passive microwave devices, microwave tubes, semiconductor microwave electronics, microwave masers, parametric amplifiers. (*Lec. 3*) *Prerequisite: ELE 411 concurrently or permission of instructor.* Daly
- 515 Quantum Electronics** *I or II, 3*
 Laser engineering and applications, interaction of radiation with atoms, optical resonators, electro-optic modulation, harmonic generation, parametric oscillation and frequency conversion, noise in laser amplifiers and oscillators. (*Lec. 3*) *Prerequisite: PHY 341 or permission of instructor.* Daly
- 516 Planetary Electrodynamics** *I or II, 3*
 An introduction to the description and theory of natural electric and magnetic phenomena on the earth and in the solar system such as lightning, natural geomagnetic and interplanetary magnetic fields, origin and properties of ionospheres, the "solar wind" and natural radio noise. (*Lec. 3*) *Prerequisite: permission of instructor.* Polk
- 517 Magnetofluidmechanics**
 See Mechanical Engineering 517.
- 520 Fourier Optics** *I or II, 3*
 Application of Fourier analysis in optical imaging and data-processing. Systems concepts will be stressed. Scalar diffraction, lenses, coherent and incoherent imaging, spatial filtering and optical information processing, and holography. (*Lec. 3*) *Prerequisite: ELE 313 or an equivalent basic knowledge of Fourier analysis.* Spence
- 531 Solid State Engineering I** *I and II, 3*
 Periodicity of solids; dielectric, thermal, optical and electro-magnetic properties of electronically interesting solids. (*Lec. 3*) *Prerequisite: ELE 431 or equivalent.* Staff
- 532 Solid State Engineering II** *I and II, 3*
 Semiconductor physics, transport properties. Applications including solid state lasers, piezoelectric, ferroelectric and magnetic devices. (*Lec. 3*) *Prerequisite: ELE 531 or equivalent.* Staff
- 535 Transistor Circuits** *I and II, 3*
 Semiconductors, characteristics of junction transistors. Analysis and design of single and multistage amplifiers including feedback. High frequency considerations, applications to systems. (*Lec. 3*) Staff
- 536 Semiconductor Electronics** *I or II, 3*
 Theory and technology of semiconductor devices. Junction, field effect, optoelectronic and microwave devices. Integrated circuits. (*Lec. 3*) *Prerequisite: ELE 431 or equivalent.* Sadasiv

F71

537 Electronic Instrumentation and Control Circuits *I and II, 3*

Analysis and design of special amplifiers, operational circuitry, measurement of non-electrical quantities, transducers. (Lec. 3) Staff

538 Principles of Remote Sensing *I or II, 3*

The theory and techniques of remote sensing including spaceborne photometry and radiometry. Applications will be selected from the following topics: planetary atmospheres, geology and earth resources, and environmental problems. (Lec. 3) *Prerequisite:* ELE 323, PHY 406, or permission of instructor. Zirkind

539 Infrared Imaging Techniques *I or II, 3*

Elemental detectors and their application in radiometers and scanners. Principles of infrared imaging devices. Thermal radiation and its propagation through the atmosphere. (Lec. 3) *Prerequisite:* ELE 437 or equivalent. Zirkind

545 Optimization and Variational Problems in Electrical Engineering *I or II, 3*

Application of variational and approximation techniques to boundary value field problems, extremal control of dynamic systems, and optimization in communication theory. Performance criteria, Hamilton-Jacobi theory; Ritz and Galerkin methods; Weinstein and Bazly methods for determining the upper and lower bounds of eigenvalues in engineering problems; optimal filter theory. (Lec. 3) *Prerequisite:* ELE 501 or 511 or permission of instructor. Poularikas

561 Information Transmission *I or II, 3*

Introduction to information theory. Discrete and continuous communications channels. Techniques for coding and decoding information. (Lec. 3) *Prerequisite:* ELE 509 or equivalent. Kelley and Spence

565 Fundamentals of Signal Theory *I and II, 3*

Concepts of signal expansions in sets of orthogonal functions other than Fourier, classification of signal types. Optimum representation vocabulary, matrix analysis. (Lec. 3) *Prerequisite:* ELE 501 or equivalent.

571 (or ECE 571) Underwater Acoustics I *I, 3*

Wave equation, stress-strain relations, energy, pressure and particle velocity. Ray theory, normal modes, refraction, reflection, layered media, scattering, with particular emphasis on sound propagation in the ocean. Acoustic properties of the sea, properties of solids. (Lec. 3) Middleton

575 Electroacoustical Engineering I *I and II, 3*

Theory and design of electroacoustic transmission channels and the psychoacoustic aspects of their use for high-quality music transmissions. (Lec. 2, Lab. 3) *Prerequisite:* permission of instructor. Etzold

576 Electroacoustical Engineering II *I and II, 3*

Storage of sound, studio-design and acoustical measurements. (Lec. 2, Lab. 3) *Prerequisite:* ELE 575. Etzold

581 Intelligence in Machines and Humans

See Computer Science 581.

586 Biomedical Electronics I *I and II, 3*

Design and analysis of biomedical instrumentation and transducers for both implantation and external use. Direct current and wide band amplifiers, counter, trigger and timing circuits. (Lec. 3) *Prerequisite:* ELE 342 or equivalent. Hubbell

587 Biomedical Electronics II *I and II, 3*

Principles of bio-telemetry. Measurement of cardiovascular, metabolic and respiratory activity under dynamic conditions. Use of ultrasonics and microwaves in measuring properties of physiological tissue. (Lec. 3) *Prerequisite:* permission of department. Hubbell

588 Biomedical Engineering I *I and II, 3*

Origin and characteristics of electrical potentials, transport and diffusion phenomena, dielectric and thermal properties of physiological material. Principles of electromyography, electrocardiography, and electroencephalography. Neural pathways and synaptic transmissions. (Lec. 3) *Prerequisite:* permission of department. Taught in cooperation with zoology and pharmacology departments. Staff

589 Biomedical Engineering II *I and II, 3*

Study and analysis of cardiovascular, respiratory, neurological, muscular, gastrointestinal and urinary systems using mathematical tools, electronic and analog models. Use of computers for biomedical data analysis and processing. Correlation and auto correlation techniques. (Lec. 3) *Prerequisite:* permission of department. Taught in cooperation with zoology and pharmacology departments. Staff

591, 592 Special Problems *I and II, 1-3 each*

Advanced work under supervision of a staff member. Arranged to suit individual requirements of student. Credits not to exceed a total of 6. *Prerequisite:* permission of department. Staff

599 Masters Thesis Research *I and II*

Number of credits is determined each semester in consultation with the major professor or program committee.

601, 602 Graduate Seminar *I and II, 1 each*

Seminar discussions including the presentation of papers based on research or detailed literature surveys. (Lec. 1) Attendance is required of all students in graduate residence, but a maximum of 1 credit per year is allowed and no more than 2 credits are allowed for the entire period of residence. Staff

605 Non-linear System Analysis *I and II, 3*

Iteration and perturbation techniques, phase plane and state space concepts, Liapunov's direct method, stability criteria for non-linear systems. (Lec. 3) *Prerequisite:* ELE 501 or equivalent. Lindgren

613 Waveguides and Resonators *II, 3*

Theory of homogeneous isotropic waveguides and

cavity resonators. (Lec. 3) *Prerequisite: ELE 511 or equivalent.* Daly or Poularikas

615 Antennas and Radio Propagation *I and II, 3*
Analysis of simple linear and area antennas. Antenna arrays. Diffraction theory. Introduction to radio propagation. (Lec. 3) *Prerequisite: ELE 511 or equivalent.* Spence or Polk

616 Advanced Topics in Electromagnetic Theory *II, 3*
Electromagnetic theory of inhomogeneous and anisotropic media. Ferrite devices. Introduction to the theory of plasmas. Ionospheric radio propagation. (Lec. 3) *Prerequisite: ELE 511, 613, 615, or equivalent.* Daly or Polk

631 Electronics of Solids I *I and II, 3*
Properties of conductors, semiconductors, and insulators from quantum mechanical principles. Band theory of solids, superconductivity, thermoelectricity. (Lec. 3) *Prerequisite: PHY 570 or equivalent.* Mitra

632 Electronics of Solids II *I and II, 3*
Extension of ELE 631, directed toward the examination of theoretical concepts fundamental to solid state electronics. Topics oriented toward current research programs and selected from areas such as quantum electronics, transport properties in strong electric and magnetic fields, and superconductivity. (Lec. 3) *Prerequisite: ELE 631 or equivalent.* Mitra

636 Solid State Electronic Devices *I or II, 3*
Selected topics of current research interest. Materials will be drawn from recent literature on solid state electronic devices. (Lec. 3) *Prerequisite: ELE 536.* Sadasiv

637 Photo-electronics I *I, 3*
Optics, including photometry, radiometry, natural illumination, irradiance, luminance, radiance, temperature. Theory, analysis and specifications of photodetectors, scanners and associated systems. Direct viewing image tubes, their components and electron optics. (Lec. 3) *Prerequisite: ELE 437 or equivalent.* Staff

638 Photo-electronics II *II, 3*
Continuation of ELE 637: theory, analysis, specifications of signal generating (remote) tubes and solid state devices, including transfer characteristics, spectral responses, limiting resolution, modulation transfer function, quantum detective efficiency. Applications to medicine, space, night vision. (Lec. 3) *Prerequisite: ELE 637.* Nudelman and Sadasiv

641 Advanced Engineering Analysis I *I, 3*
Analytical techniques for the solution of problems involving a finite number of degrees of freedom with applications to linear and non-linear systems. (Lec. 3) *Prerequisite: advanced graduate standing and permission of instructor.* Staff

642 Advanced Engineering Analysis II *II, 3*
Continuation of ELE 641. Techniques for the analy-

sis of distributed parameter systems. Applications to diffusion problems and wave propagation. (Lec. 3) Staff

651 Feedback Control Systems I *I, 3*
Analysis of synthesis of complex control systems. Extension of feedback control theory to handle random disturbances, sampled data, and non-linearities. System optimization. (Lec. 3) *Prerequisite: ELE 457 or equivalent.* Lindgren

652 Feedback Control Systems II *II, 3*
Continuation of ELE 651. Topics from current research such as stability of non-linear and time-varying systems, optimal control, self-optimizing systems and learning systems. (Lec. 3) *Prerequisite: ELE 651.* Staff

660 Advanced Topics in System Theory *I or II, 3*
Seminar for advanced students. Selected topics of current research interest. Material will be drawn primarily from recent literature. (Lec. 3) *Prerequisite: permission of instructor.* Staff

665 Detection, Estimation and Modulation Theory *I or II, 3*
Advanced treatment of statistical detection, estimation and modulation theory. Applications to communication systems and radar and sonar systems. (Lec. 3) *Prerequisite: ELE 509 or equivalent and competence in probability and statistics.* Staff

672 (or OCE 672) Underwater Acoustics II *II, 3*
Transducers, radiators and receivers, directivity (array structures), equivalent circuits, efficiency; piezoelectricity, magnetostriction, sonar principles, measurements and calibration. (Lec. 3). Middleton

691, 692 Special Problems *I and II, 1-3 each*
Advanced work under supervision of a staff member. Arranged to suit individual requirements of student. Credits not to exceed a total of 6. *Prerequisite: permission of department.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

ENGLISH (ENG)

433 The Elizabethan Drama *II, 3*

440 Literary Heritage of New England to 1860 *I, 3*

441, 442 American Authors *I and II, 3 each*

444 The American Writer and the Negro *II, 3*

445 American Romanticism *II, 3*

446 Modern American Drama *II, 3*

- 450 The English Renaissance II, 3 *tor. In alternate years, next offered 1974-75. Goldman*
- 452 The Seventeenth Century, 1603-1660 I, 3
- 453 The Restoration Period II, 3 *F 535 Old English I, 3*
72 Introduction to the language and literature. (Lec. 3)
Prerequisite: graduate standing or permission of instructor. In alternate years, next offered in 1974-75. Malina and Mensel
- 456 The Augustan Tradition in England I, 3
- 457 The Age of Johnson II, 3
- 461 The Classical Epic I, 3 *536 Problems in Linguistics and Literature II, 3*
73 Recent developments in linguistics and their application to the study of literature. (Lec. 3). *Prerequisite: graduate standing or permission of instructor. In alternate years, next offered in 1974-75. Titus*
- 462 The Medieval and Modern Epic II, 3
- 465 Greek and Roman Drama I, 3
- 470 Chaucer I, 3
- 472, 473 Shakespeare I and II, 3 each
- 474 Milton II, 3
- 475 Major English Authors of the Eighteenth Century I or II, 3 *540 Modern American Novel I, 3*
7 Important American novelists of the twentieth century with emphasis on major developments in ideas and techniques. (Lec. 3) *Prerequisite: graduate standing or permission of instructor. Hoffmann, Marshall and Gullason*
- 476 Browning II, 3
- 480 The Romantic Movement, 1798-1832 I, 3
- 482, 483 English Literature, 1832-1900 I and II, 3 each
- 484 Modern British Literature II, 3 *545 Problems in American Realism and Naturalism I, 3*
7 Readings, discussions, and papers on stylistic, thematic, and philosophic issues relating to literary artists like Howells, James, Crane, Dreiser, Hemingway, and others. (Lec. 3) *Prerequisite: graduate standing or permission of instructor. Gullason*
- new 72-73* 510 Bibliography and Literary Research II, 3
 Use of descriptive and analytical bibliography, various modes of literary criticism, and other scholarly tools in the solution of literary research problems. (Lec. 3) *Prerequisite: graduate standing or permission of instructor. In alternate years, next offered in 1974-75. Titus and Tutt*
- 530 History of the English Language I, 3*
7 Historical study of development of English syntax, sounds, vocabulary and usage. (Lec. 3) *Prerequisite: graduate standing or permission of the instructor. Titus*
- 531 History of Critical Theory I, 3*
7 Important critical theories from Aristotle to the twentieth century. Emphasis upon orientation of theories to various aspects of the literary situation. Some study of modern attitudes toward earlier critics. Open to graduate students and senior English majors. (Lec. 3) *Prerequisite: graduate standing or permission of instructor. Murphy*
- 532 Modern Literary Criticism II, 3*
72 Dominant modes and schools of criticism exemplified by T. S. Eliot, T. E. Hulme, I. A. Richards, Edmund Wilson, John Crowe Ransom, and other important critics. Pertinent related literary works. (Lec. 3) *Prerequisite: graduate standing or permission of instructor. In alternate years, next offered 1974-75. Goldman*
- new 72-73* 547 Early American Literature to 1800 I, 3
 Thorough examination of Colonial and Federal literature with some discussion given to the beginnings of Romanticism. Special attention given to Taylor, Edwards, Franklin, Freneau and Charles Brockden Brown. (Lec. 3) *Prerequisite: graduate standing or permission of instructor. In alternate years, next offered in 1975-76. Schoonover and Marshall*
- 548 American Poetry to 1900 I, 3*
72 Important colonial and nineteenth century American poets with emphasis on major trends in ideas and techniques. (Lec. 3) *Prerequisite: graduate standing or permission of instructor. In alternate years, next offered in 1974-75. Robinson, Potter and Collins*
- 549 Modern American Poetry II, 3*
7 In-depth study of several major American poets, such as Eliot, Pound, Frost, Stevens, Williams, and others; or of a school, such as the Imagists, the Fugitives, and others. (Lec. 3) *Prerequisite: graduate standing or permission of instructor. Goldman and Potter*
- 550 Middle English Literature II, 3*
7 Selections from Middle English literature exclusive of Chaucer. Works by Malory, the Pearl-Poet, Gower, the Wakefield Master, and others. (Lec. 3) *Prerequisite: graduate standing or permission of instructor. In alternate years, next offered 1974-75. Goldman*

site: graduate standing or permission of instructor. MacLaine

551 The Metaphysical Poets

I, 3

Intensive analysis and interpretation of poetry of Donne, Herbert, Vaughan, Crashaw, and Marvell. (Lec. 3) *Prerequisite: graduate standing or permission of instructor. In alternate years, next offered 1973-74.* Sorlien

554 Modern British Poetry

I, 3

In-depth study of several major British poets, such as Yeats, Lawrence, Auden, Thomas, MacNeice, and others; or of a school such as the War Poets (WWI), and others. (Lec. 3) *Prerequisite: graduate standing or permission of instructor. In alternate years, next offered 1973-74.* Goldman and Matthews

555 Modern British Novel

I, 3

Important British novelists of twentieth century with emphasis on major trends in ideas and techniques. (Lec. 3) *Prerequisite: graduate standing or permission of instructor.* Hoffmann

556 English Literature of the Sixteenth Century

I, 3

Early humanism. Tudor poetry and its continental antecedents. Satire and translation. Elizabethan voyage literature. Writers chosen from More, Erasmus, Skelton, Wyatt, Surrey, Sidney, Spenser, Marlow, Hakluyt, Lodge, Shakespeare and others. (Lec. 3) *Prerequisite: graduate standing or permission of instructor.* Murphy, Sorlien and Hills

557 English Literature of the Seventeenth Century

II, 3

Selected poets and prose writers, studies for their contribution to the dominant themes and modes of expression of the Stuart and Cromwellian eras. (Lec. 3) *Prerequisite: graduate standing or permission of instructor.* Sorlien and Jacobs

558 English Literature of the Eighteenth Century

I, 3

Intensive study of major and selected minor figures of the eighteenth century. Emphasis on verse and non-fiction prose with some attention given to the developments of the drama. (Lec. 3) *Prerequisite: graduate standing or permission of instructor.* Joel, Kunz and Reaves

559 English Literature of the Romantic Period

II, 3

Selections from the major works and writers of the Romantic Movement. (Lec. 3) *Prerequisite: graduate standing or permission of instructor. In alternate years, next offered in 1974-75.* Petrie, Seigel and Tutt

560 English Literature of the Victorian Period

II, 3

Selections from the major works and writers of the Victorian Period. (Lec. 3) *Prerequisite: graduate standing or permission of instructor. In alternate years, next offered in 1973-74.* Goldman and Seigel

561 Modern European Novel

II, 3

Major developments in European novel during twentieth century. Special attention to Proust, Mann, Kafka, Moravia, Silone, Lagerkvist, Malraux and Camus. (Lec. 3) *Prerequisite: graduate standing or permission of instructor. In alternate years, next offered 1973-74.* Gullason

570 Anglo-Irish Writers

II, 3

The Celtic Renaissance as a literary movement, its importance and influence. AE, Lady Gregory, Joyce, O'Casey, O'Flaherty, Stephens, Synge, Yeats, and others. (Lec. 3) *Prerequisite: graduate standing or permission of instructor.* Murphy

571 Problems in Chaucer

I, 3

Intensive study of selected aspects of Chaucer's achievement as a poet. Emphasis on *The Canterbury Tales*. (Lec. 3) *Prerequisite: graduate standing or permission of instructor. In alternate years, next offered in 1974-75.* MacLaine, Malina and Mensel

572 Spenser

II, 3

The major poetry, with special emphasis on *The Faerie Queen*. (Lec. 3) *Prerequisite: graduate standing or permission of instructor. In alternate years, next offered 1973-74.* Neuse

573 Problems in Shakespeare

II, 3

Primarily a discussion course, concentrating on plays and characters that offer most interesting problems for student analysis. Solutions by leading critics are examined. (Lec. 3) *Prerequisite: permission of instructor.* Smith

574 The Scots' Poetic Tradition through Robert Burns

I, 3

Intensive study of the poetry of Robert Burns, Fergusson, Ramsay, and others who sparked the Scottish revival. (Lec. 3) *Prerequisite: graduate standing or permission of instructor. In alternate years, next offered 1974-75.* MacLaine

575 Modern Southern Literary Renaissance

II, 3

Comprehensive study of a major literary movement. Representative works by Faulkner, Wolfe, Warren, Williams, Porter, Welty, O'Connor, and others. (Lec. 3) *Prerequisite: graduate standing or permission of instructor. In alternate years, next offered in 1974-75.* Gullason

576 English Novel of the Eighteenth Century

I, 3

Selected novels of Defoe, Richardson, Fielding, Smollett, Sterne, and Austen, with consideration of major criticism and of disparate influences on the emergence of the novel. (Lec. 3) *Prerequisite: graduate standing or permission of instructor. In alternate years, next offered 1973-74.* Joel and Kunz

577 English Novel of the Nineteenth Century

I, 3

Important British novelists of the nineteenth century with emphasis on trends in ideas and techniques of Victorian novelists. (Lec. 3) *Prerequisite: graduate*

standing or permission of instructor. In alternate years, next offered in 1974-75. Hoffman, McCabe and Seigel

578 Problems in Milton *II, 3*
Emphasis on the major poetic works. (Lec. 3) *Prerequisite: graduate standing or permission of instructor. In alternate years, next offered in 1974-75.* Neuse

590 Selected Topics *I and II, 3*
Selected topics in American and British literature, and topics of special interest not covered by traditional department offerings. (Lec. 3) *Prerequisite: graduate standing or permission of instructor. Fall, 1973: Early Southern Literature, Tutt. Spring, 1974: Forms of Modern Tragedy, Gullason*

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

631 Seminar in Old English *II, 3*
Advanced readings in Old English literature. (Lec. 3) *Prerequisite: ENG 535.* Malina and Mensel

Courses 640 through 661 are lectures, discussions, extensive readings, individual research, and a substantial research paper. (Lec. 3) *Prerequisite: permission of department.*

640, 641 Seminar in American Literature before 1900 *I and II, 3 each*
Fall, 1973: Poe, Robinson. Spring, 1974: Emerson-Thoreau, Marshall

642, 643 Seminar in Modern Literature (American) *I and II, 3 each*
Fall, 1973: Modern American Drama, Miller. Fall, 1974: Faulkner, Hoffmann

650, 651 Seminar in English Literature of the Middle Ages *I and II, 3 each*
Spring, 1974: Arthurian Theme, Neuse. Spring, 1975: Medieval Romance, Neuse

652, 653 Seminar in English Literature of the Sixteenth Century *I and II, 3 each*
Fall, 1973: Shakespeare, Barker. Spring, 1974: Marlowe and Jonson, Smith. Fall, 1974: Renaissance Humanism, Murphy

654, 655 Seminar in English Literature of the Seventeenth Century *I and II, 3 each*
Fall, 1973: Verse Satire; Donne through Dryden, Sorlien. Fall, 1974: Art and Literature, Jacobs. Spring, 1975: Donne, Sorlien

656, 657 Seminar in English Literature of the Eighteenth Century *I and II, 3 each*
Spring, 1974: Literary and Aesthetic Criticism,

Reaves. Fall, 1974: Defoe and Swift, Kunz. Spring, 1975: Burns, MacLaine

658, 659 Seminar in English Literature of the Nineteenth Century *I and II, 3 each*
Fall, 1973: The Victorian Hero, Seigel. Fall, 1974: Carlyle, Seigel

660, 661 Seminar in Modern Literature (English) *I and II, 3 each*
Fall, 1973: British Novels since 1945, Sharpe. Fall, 1974, TBA. Spring, 1975: The Psychological Novel, Hoffmann

691, 692 Special Problems *I and II, 3 each*
Advanced study of an approved topic, under the supervision of a member of the staff. (Lec. 3) *Prerequisite: permission of department.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

EXPERIMENTAL STATISTICS (EST)

408 (411) Statistical Methods in Research I *I and II, 3*

409 (411) Statistical Methods in Research I *I, 3*

412 Statistical Methods in Research II *II, 3*

500 Nonparametric Statistical Methods *II, 3*
Inference problems arising when sampling from populations that are not assumed to have a particular functional form. Topics include: rank and sign tests, permutation tests and randomization, estimation, and comparison with parametric procedures. Examples illustrating the applications of non-parametric techniques. (Lec. 3) *Prerequisite: EST 408 or 409.* Lawing and Hanumara

511 Linear Statistical Models *I, 3*
Review of mathematical and statistical concepts. The multivariate normal distribution. Distribution of quadratic forms. Power of the F-test. The basic linear models: the general linear hypothesis, regression models, experimental design models, variance component models, mixed models. (Lec. 3) *Prerequisite: MTH 215 and EST 412 or MTH 452.* Carney

520 Fundamentals of Sampling and Applications *II, 3*
Simple random sampling; properties of estimates, estimation of standard errors, confidence limits. Estimation of sample size; stratified random sampling; optimum allocation, effects of errors, and quota sampling. Regression estimates; systematic and sequential sampling. (Lec. 3) *Prerequisite: EST 408 or 409.* Carney and Hanumara

532 (or ASC 532 or PSY 532) **Experimental Design** *I or II, 3*
 Application of statistical methods to biological and psychological research and experimentation. Discussion of experimental situations for which various ANOVA and ANCOVA designs are most suitable. (Lec. 3) *Prerequisite: EST 408 or 409 or equivalent.* Archer, I; Smith, II

541 **Multivariate Statistical Methods** *I, 3*
 Review of mathematical concepts in matrix analysis. Multivariate normal distribution. Tests of hypotheses on means, Hotelling's T^2 , discriminant functions. Multivariate regression analysis. Canonical correlations. Principal components. Factor analysis. (Lec. 3) *Prerequisite: EST 412 or PSY 510.* Hanumara and Hemmerle

576 **Econometrics I**
 See Resource Economics 576.

577 **Econometrics II**
 See Resource Economics 577.

591, 592 **Problems in Experimental Statistics** *I and II, 1-3 each*
 Advanced work in experimental statistics. Study of recent developments in data analysis. Courses will be conducted as seminars or as supervised individual topics. *Prerequisite: permission of department.* Staff

599 **Masters Thesis Research** *I and II*
 Number of credits is determined each semester in consultation with the major professor or program committee.

610 **Factor Analysis**
 See Psychology 610.

635 **Response Surfaces and Evolutionary Operations**
 See Industrial Engineering 635.

FINANCE (FIN)

410 **Capital Markets** *I and II, 3*

415 **Working Capital Management** *I, 3*

416 **Long-Term Investment and Financing to Intermediate Financial Management Theory** *II, 3*

433 **Bank Financial Management** *I, 3*

440 **Problems in Security Investments** *II, 3*

452 **International Financial Management** *II, 3*

491, 492 **Special Problems** *I and II, 3 each*

540 (940) **Theory of Finance** *I and II, 2*
 Uses of financial instruments, problems of capital financing, financial expansion and reorganization, oper-

ations of specialized financial institutions. (Lec. 2) Staff

641 **Advanced Financial Theory** *I and II, 3*
 Role of the financial manager in analysis, profit planning and control activities. Emphasis placed on the goals, basic concepts and tools of decision making as applied to working capital management, capital budgeting and capital structure decisions. (Lec. 3) *Prerequisite: FIN 540.* Staff

648 **Financial Cases and Readings** *I and II, 3*
 Problems and decisions as to the management of funds. Case method used. (Lec. 3) *Prerequisite: FIN 641.* Staff

649 **Seminar in Finance** *I and II, 3*
 Independent research. Individual topics based on readings and research interests of the students. (Lec. 3) *Prerequisite: FIN 641.* Staff

FISHERIES AND MARINE TECHNOLOGY (FMT)

416 **Marine Transportation** *II, 3*

452 **Industrial Fishery Technology** *II, 3*

FOOD AND NUTRITIONAL SCIENCE (FNS)

401, 402 **Special Problems** *I and II, 2-4 each*

438 **Experimental Food Science** *II, 3*

441 **Advanced Human Nutrition** *I, 3*

444 **Diet Therapy** *II, 3*

445 **Readings in Nutrition** *II, 2*

502 **Advanced Experimental Foods** *II, 3*
 Application of the principles of food science and technology in the development of food products, considering effective methods of preparation, processing and preservation, and the control and evaluation of food product quality. (Lab. 6) *Prerequisite: permission of department.* Staff

503 **Nutrition Research Methods** *I, 3*
 Comprehensive study of literature. Practice in techniques and methods as applied to animal and human nutrition research. (Lec. 1, Lab. 4) *Prerequisite: permission of department.* Staff

504 **Food Science and Nutrition Seminar** *II, 3*
 Studies and discussion of recent research. Presentation of papers on selected topics from basic and applied food science and nutrition. (Lec. 3) *Prerequisite: permission of department.* Staff

F12

505, 506 Marine Foods Seminar *I and II, 1 each*
Study of current problems of marine foods such as those concerned with the resource, supply, health safety, nutritive value, preservation and consumer acceptability. Participation by students, faculty, and visiting lecturers. (*Lec. 1*) *Prerequisite: permission of department.* Staff

531 Teaching of Nutrition

See Education 531.

F12 5

591, 592 Special Research Problems *I and II, 2-4 each*
Advanced work under supervision of staff member. Arranged to suit individual requirements of students. *Prerequisite: permission of department. For graduate students only.* Staff

F 5

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

FOOD AND RESOURCE CHEMISTRY (FRC)

411 (or PLS 411) Soil Chemistry and Fertilizers *I, 3*

412 (or PLS 412) Soil Biochemistry *II, 3*

431 Biochemistry of Foods *I, 3*

432 Biochemistry of Food Processing *II, 3*

452 Plant Biochemistry *II, 3*

491, 492 Special Projects *I and II, 3 each*

F 5

501, 502 Seminar *I and II, 1 each*
Preparation and presentation of papers on subjects in selected areas relating to Food and Resource Chemistry. Staff

F 5

521 Pesticide Chemistry *I, 3*
Nomenclature, chemical and physical properties, mode of action, and methods of analysis of insecticides, fungicides and herbicides. (*Lec. 2, Lab. 3*) *Prerequisite: organic chemistry.* Olney

F 13

526 (or MCH 526) Lipid Chemistry *II, 3*
Advanced course in the chemistry of biologically important lipids such as the fatty acids, neutral glycerides, phospholipids, steroids, and the chemistry and biochemistry of the carotenoids. (*Lec. 3*) *Prerequisite: BCH 581.* Olney, J. G. Quinn, Simpson, and Turcotte

F 5

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

F 12

691, 692 Research in Food and Resource Chemistry *I and II, 3 each*
Assigned research on an advanced level. Student is required to outline problem, conduct the necessary

literature survey and experimental work, and to present his observations and conclusions in a report. Staff

F 5

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

FOOD SERVICES (FDS)

481, 482 Special Problems *I and II, 2-4 each*

FOREST AND WILDLIFE MANAGEMENT (FOR)

401 Forest Influences *I, 3*

402 Wildlife Populations *II, 3*

421 The Wetland Environment *I, 3*

491, 492 Special Projects *I and II, 1-3 each*

FRENCH (FRN)

402 French Phonetics *II, 3*

411 Medieval French Literature *I, 3*

422 French Literature of the Renaissance *II, 3*

431, 432 French Literature of the Seventeenth Century *I and II, 3 each*

441, 442 French Literature of the Eighteenth Century *I and II, 3 each*

451 Romanticism *I, 3*

452 Realism and Symbolism *II, 3*

461 Drama of the Twentieth Century *I, 3*

462 Poetry of the Twentieth Century *II, 3*

463 Twentieth-Century Prose through 1950 *I, 3*

464 Twentieth-Century Prose since 1950 *II, 3*

471 Black French Prose and Poetry *I or II, 3*

472 Black and Arab French Theater *II, 3*

497, 498 Directed Study *I and II, 3 each*

F 12

501 Advanced Composition *I, 3*
Primarily a course in stylistics designed to prepare undergraduate and graduate majors to write expository

tory French prose. (Lec. 3) *Prerequisite: graduate status or permission of instructor.* Porter

Voltaire and Beaumarchais. (Lec. 3) *Prerequisite: graduate status or permission of instructor.* Rothschild

502 Stylistics II, 3
 Emphasis on acquisition of ability to write at length in an acceptable literary style. Each student will be expected to prepare a study of monograph length on an appropriate subject. (Lec. 3) *Prerequisite: FRN 501 or equivalent.* Porter

503, 504 History of the French Language
I and II, 3 each

Linguistic development of French from the *Serments de Strasbourg* to the end of the Middle Ages. Particular attention to sound and form changes. (Lec. 3) *Prerequisite: graduate status or permission of instructor.* Porter

511, 512 French Literature of the Middle Ages
I and II, 3 each

Intensive study of French literature in the medieval period. Reading of selected texts and discussion of the literary values of Old French. (Lec. 3) *Prerequisite: graduate status or permission of instructor.* Porter

521 The French Renaissance I, 3
 Examination of the origins and development of the Renaissance in France as seen in the writings of Rabelais and the poets of his time. (Lec. 3) *Prerequisite: graduate status or permission of instructor.* Benson

522 The Rise of Introspective Writings in Sixteenth Century France II, 3
 Thematic study of self-analysis as practiced by Montaigne and his contemporaries. (Lec. 3) *Prerequisite: graduate status or permission of instructor.* Benson

531 The Tragic Theater of the Seventeenth Century I, 3
 French tragic theater in the seventeenth century, with particular attention to the works and influence of Corneille and Racine. (Lec. 3) *Prerequisite: graduate status or permission of instructor.* Morello

532 The Comic Theater of the Seventeenth Century II, 3
 French comic theater of the seventeenth century, with particular attention to the works and influence of Molière. (Lec. 3) *Prerequisite: graduate status or permission of instructor.* Morello

541 The Age of Enlightenment II, 3
 Intellectual trends in seventeenth-century French literature as it relates to the important eighteenth century philosophical production of Montesquieu, Voltaire, Buffon, Diderot and others. (Lec. 3) *Prerequisite: graduate status or permission of instructor.* Rothschild

542 The Theater of the Eighteenth Century I, 3
 Theater of the eighteenth century, with emphasis on the dramatic works of Regnard, LeSage, Marivaux,

543 The Novel of the Seventeenth and Eighteenth Centuries I, 3
 Evolution of the French novel, with emphasis on writers such as D'Urfé, Scarron, Mme. de Lafayette, LeSage, Marivaux, Prévost, Voltaire and Diderot. (Lec. 3) *Prerequisite: graduate status or permission of instructor.* Rothschild

551 The Romantic Movement I, 3
 Detailed study of the chief proponents of the movement, particularly Chateaubriand, Mme. de Staël, Constant, Lamartine, Hugo, Vigny, Musset, Sand et al. (Lec. 3) *Prerequisite: graduate status or permission of instructor.* Toloudis

552 Realism and Naturalism I, 3
 French Realism and Naturalism as illustrated in Balzac, Flaubert, Zola, de Maupassant, the Goncourt et al. (Lec. 3) *Prerequisite: graduate status or permission of instructor.* Chartier

553 The Symbolist Movement I, 3
 Intensive study of poetry of Baudelaire, Verlaine, Rimbaud, Mallarmé and of their sources and influence. (Lec. 3) *Prerequisite: graduate status or permission of instructor.* Chartier

561 Contemporary French Theater through 1950 I and II, 3
 Survey of important dramatists and *metteurs en scène* from Symbolism and Realism through 1950. (Lec. 3) *Prerequisite: graduate status or permission of instructor.* Toloudis

562 French Theater since 1950 II, 3
 Emphasis on recent developments such as the theater of the absurd and social theater. (Lec. 3) *Prerequisite: graduate status or permission of instructor.* Waters

563 The Novel of the Twentieth Century I, 3
 Intensive study of major novelists with emphasis on trends in philosophies and in techniques as illustrated by such authors as Gide, Mauriac, Malraux, Saint-Exupéry, Sartre, Camus, et al. (Lec. 3) *Prerequisite: graduate status or permission of instructor.* Toloudis

591 Proust and Claudel II, 3
 Analysis and interpretation of the imaginative writings of Proust and Claudel. (Lec. 3) *Prerequisite: graduate status or permission of instructor.* Waters

594 Special Problems I and II, 3
 Group and/or individual investigation of special problems in French literature. Staff

599 Masters Thesis Research I and II
 Number of credits is determined each semester in consultation with the major professor or program committee.

901, 902 Reading Course in French for Graduate Students *I and II, 0*

901: Fundamentals of grammar and syntax necessary to develop reading knowledge. Assumes no prior knowledge of French. *FRN 902*: Exercises in reading scholarly and scientific texts. Hyland

**GENERAL BUSINESS
ADMINISTRATION (GBA)**

410 Business Policy *II, 3*

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655 International Business Administration *I and II, 3*
Problems and policies of international business enterprise; economic, legal, political, social and cultural aspects. (*Lec. 3*) *Prerequisite: permission of department.* Staff

5

7571 Methods of Business Research *I and II, 3*
Toward an understanding of the role, spirit, and methodology of business research. Assigned research projects. (*Lec. 3*) *Prerequisite: MGS 581 or equivalent and permission of department.* Poulsen

681 Administrative Policy and Decision-making *I and II, 3*

Review of the functional areas of marketing, production, finance, economics, accounting, quantitative methods, organization theory, interpersonal relationships, control and motivation systems, and communications. Includes the M.B.A. written comprehensive examination according to Graduate School requirements. (*Lec. 3*) *Prerequisite: all M.B.A. foundation courses or undergraduate equivalents and a minimum of 21 M.B.A. credits at the 600 level which must include MMG 651, FIN 641, ACC 611.* Staff

691 Directed Study in Administration *I and II, 1-3*

Advanced work under the supervision of a member of the staff and arranged to suit the individual requirements of the student. (*Lec. 1-3*) *Prerequisite: permission of M.B.A. director.* Staff

5-692

GENETICS

Animal Science

470 Population Genetics

Microbiology

552 Microbial Genetics

Botany

554 Cytogenetics

579 Advanced Genetics Seminar

Plant and Soil Science

472 Plant Improvement

Zoology

471 Evolution

476 Human Genetics

576 Ecological Genetics

579 Advanced Genetics Seminar

GEOGRAPHY (GEG)

403 Meteorology and Climatology I *I, 3*

404 Meteorology and Climatology II *II, 3*

407 Selected Topics in Meteorology *I, 2*

411 Urban Geography *I, 3*

412 Seminar in Urban Geography *I and II, 3*

421 Introductory Cartography *I and II, 3*

422 Advanced Cartography *II, 3*

432 Seminar in Political Geography *II, 3*

441 Geography of Europe *I, 3*

442 Geography of the Soviet Union *I, 3*

443 Geography of the United States and Canada *II, 3*

444 Geography of the Middle East and the Indian Subcontinent *II, 3*

445 Geography of Modernization in Africa *II, 3*

446 Geography of the Polar Regions *II, 3*

451 Land Utilization *I, 3*

452 Transportation Geography *II, 3*

463 Geography of World Resources *II, 3*

491, 492 Special Problems in Geography *I and II, 3 each*

502 Research Methods in Geography *I, 3*

Fundamentals of geographic research, including techniques of field observation and interpretation, and the introduction to the use of the Computer Laboratory and computer package program. (*Lec. 3*) *Prerequisite: GEG 491 or permission of department.* Staff

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526 Plant Geography

See Botany 526.

542 Seminar in Economic Geography *I, 3*

Analytical approaches to rational utilization of the world's resources. Emphasis on agricultural and industrial location theory, diffusion of ideas and innovations, and recreational analysis (*Lec. 3*) *Prerequisite: GEG 103 or permission of department.* Capelle

- 5 **543 Geography of Megalopolis** I, 3
A geographical analysis of the northeastern seaboard of the United States in terms of its physical and economic foundations, its distinctiveness as a region, and the key role the analysis of Megalopolis plays in understanding incipient major conurbations in the United States and the world. (Lec. 3) *Prerequisite:* GEG 443 or 544 or permission of department. In alternate years, next offered 1973-74. Higbee

544 Historical Geography of the United States I, 3
Selected regional analysis of the United States, stressing patterns of settlement, routes of migration, frontier advance, and resource development from the colonial period into the twentieth century. (Lec. 3) *Prerequisite:* GEG 103, 443, or permission of department. Staff

- 5 **545 Geography of the North Atlantic Basin** II, 3
13 Description and analysis of the North Atlantic Ocean and its borderlands, including northeastern North America and the western littoral of Europe. Emphasis on orientation to, and use of, the marine environment, and on the role of the North Atlantic both as a uniting and divisive force in the western community. (Lec. 3) *Prerequisite:* GEG 131 or permission of department. Alexander

f **571 Marine Geography** I, 3
The marine region as a unique complex of physical and cultural elements. The purpose is to analyze functional relationships within the region and to assess forms of regional organization and control. (Lec. 3) *Prerequisite:* permission of department. Alexander

- f **591, 592 Directed Study or Research** I and II, 3 each
12 Covers areas of special research interests of graduate students. (Lec. 3) *Prerequisite:* permission of department. Staff

- 5 **595 Problems of Modernization in Developing Nations**
See Resource Economics 595.

f **599 Masters Thesis Research** I and II
5 Number of credits is determined each semester in consultation with the major professor or program committee.

GEOLOGY (GEL)

- 410 Geomorphology** I, 4
420 Mineralogy I, 4
421 Optical Mineralogy II, 4
425 Principles of Geochemistry I, 3
430 Petrology II, 4
440 Introduction to Paleontology I, 4

- 450 Introduction to Stratigraphy and Sedimentation** II, 4

- 465 Introduction to Geophysics** II, 3

- 470 Structural Geology** II, 4

- 5 **510 Coastal Geomorphology** II, 3
13 Principles of coastal development and interpretation in relation to endogenetic and exogenetic shore processes including beach formation and erosion. Former beaches on emerged coastal plains and submerged continental shelves are related to experimental model studies and applied field studies. (Lec. 3) *Prerequisite:* GEL 410, or permission of instructor. Offered in spring of odd calendar years. Fisher

- 5 **526 Igneous and Metamorphic Geochemistry** II, 3
13 Applications of elementary thermodynamics to geologic problems including phase equilibria and igneous and metamorphic reactions. Incorporates the classical approach and a survey of the current literature in the area of geochemical petrology. (Lec. 3) *Prerequisite:* GEL 425, MTH 142 or permission of instructor. Offered in spring of odd calendar years. Hermes

530 Igneous Petrology I, 3
f Tectonic and chemical bases for igneous phenomena stressing the association concept of igneous activity. Evaluation of the criteria used in petrogenetic interpretations. (Lec. 2, Lab. 3) *Prerequisite:* GEL 430 or permission of instructor. Offered in fall of odd calendar years. Cain

- 5 **531 Metamorphic Petrology** II, 3
5 Facies concept and other methods of interpreting metamorphic mineral assemblages. Chemical and fabric changes during metamorphism, including principles of structural petrology. (Lec. 2, Lab. 3) *Prerequisite:* GEL 430 or permission of instructor. Offered in spring of even calendar years. Cain

5 **541 Animal Micropaleontology** II, 3
5 Concentrated study of animal microfossils with primary emphasis on taxonomy, morphology, ecology, and stratigraphic occurrence. (Lec. 2, Lab. 3) *Prerequisite:* GEL 440 or permission of instructor. Offered in spring of even calendar years. Tynan

f **542 Plant Micropaleontology** I, 3
5 Concentrated study of plant microfossils with primary emphasis on taxonomy, morphology, ecology, and stratigraphic occurrence. (Lec. 2, Lab. 3) *Prerequisite:* GEL 541 and BOT 111, or permission of instructor. Offered in fall of even calendar years. Tynan

f **550 Sedimentation** I, 3
12 Study of sedimentary processes. Topics include the origin of the original rock, transport of clastics and dissolved materials, deposition of sediments, changes in the sediments before complete lithification, and lithification. Laboratory: comprises methods and techniques to obtain data for solution of sedimentary

problems. (Lec. 2, Lab. 3) *Prerequisite: GEL 450 or permission of instructor. Offered in fall of even calendar years.* Hampton

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551 Sedimentary Petrology II, 3
Characteristics of sediments and sedimentary rocks as a function of the environments of source, transportation, deposition, and diagenesis. (Lec. 2, Lab. 3) *Prerequisite: GEL 550 or permission of instructor. Offered in spring of odd calendar years.*

555 Stratigraphy II, 3
Study of the principles and methods used to analyze and interpret areal and time relationships of stratified rocks and the history of life contained in the rocks. (Lec. 2, Lab. 3) *Prerequisite: GEL 440 and GEL 450 or permission of instructor. Offered in spring of odd calendar years.* Tynan

500 72

561 Evaluation of Geologic Data I, 3
Discussion of the quantification of geologic data including methods and limitations of quantification. Development and evaluation of concepts of sampling, accuracy, precision, and hypothesis and model formulation as applied to geology. Sources, types, and degrees of error in sampling, measuring and presenting geologic data. (Lec. 3) *Prerequisite: two 400-level courses in geology and EST 411 or equivalent, or permission of instructor. Offered in fall of even calendar years.* Cain

581 (or OCE 581) Coastal Engineering Geology II, 3
Discussion of the interaction of geological factors and coastal structures. Shore materials, energy-material relationships, and the interference of man-made structures with the natural regimen emphasized. (Lec. 3) *Prerequisite: GEL 302 or 410, or OCG 540 or permission of instructor. Offered in spring of even calendar years.* Fisher

585 Geohydrology I, 3
Introduction to ground-water hydrology and drainage basin analysis and their relation to geomorphology, glacial geology and sedimentology. Laboratory work in analog models and analysis of water resources in various geologic environments from geologic maps and aerial photography. Field studies in geophysical methods of investigation. (Lec. 3) *Prerequisite: GEL 302 or 410 or 450 or permission of instructor. Offered in fall of odd calendar years.* Fisher

590 Special Problems I and II, 1-3
Advanced work under the supervision of a member of the staff arranged to suit the individual requirements of the student. (Lec. and/or Lab. according to the nature of the problem.) *Prerequisite: permission of instructor.* Staff

599 Masters Thesis Research I and II
Number of credits is determined each semester in consultation with the major professor or program committee.

Note: For other related courses see PHY 522 and OCG 540, 630, 631, 643, 644, 645, 647.

GERMAN (GER)

- 409 History of the German Language** I, 3
- 431 German Literature from 800 to 1700** II, 3
- 441, 442 German Literature of the Eighteenth Century** I and II, 3 each
- 451, 452 German Literature of the Nineteenth Century** I and II, 3 each
- 485, 486 Special Studies** I and II, 3 each
- 497, 498 Directed Study** I and II, 3 each
- 901, 902 Reading Course in German for Graduate Students** I and II, 0
901: Fundamentals of grammar and syntax necessary to develop reading knowledge. Assumes no prior knowledge of German. 902: Exercises in reading scholarly and scientific texts. Staff

HISTORY (HIS)

- 401 History of England, 1485-1660** I, 3
- 402 History of England, 1660-1815** II, 3
- 403 History of England, 1815-1896** I, 3
- 404 History of England since 1896** II, 3
- 405 Western Europe in the High Middle Ages** I, 3
- 406 The Renaissance** II, 3
- 408 History of Europe, 1648-1789** I, 3
- 409 The French Revolution and Napoleon** I, 3
- 410 History of Europe, 1815-1914** I, 3
- 411 History of Europe since 1914** II, 3
- 414 Seventeenth- and Eighteenth-Century European Cultural History** I, 3
- 415 Nineteenth- and Twentieth-Century European Cultural History** II, 3
- 416 History of Science to 1700** I, 3
- 417 History of Science since 1700** II, 3
- 418 Diplomatic History of Europe since 1815** I, 3
- 426 German History, 1640-1871** I, 3

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|---|------------|---|------------------|
| 427 German History since 1871 | II, 3 | 481 History of Colonial Latin America | I, 3 |
| 430 History of France since 1815 | II, 3 | 482 History of Modern Latin America | II, 3 |
| 432 History of Russia to 1917 | I, 3 | 483 History of Modern Mexico | I or II, 3 |
| 433 History of the Soviet Union | II, 3 | 488 History of Sub-Saharan Africa | I, 3 |
| 435 American Colonial History to 1763 | I, 3 | 493, 494 Topics in History | I and II, 3 each |
| 436 The American Revolution and Confederation, 1763-1789 | I, 3 | 501 Colloquium in European History | I or II, 3 |
| 437 The United States during the Early National Period, 1789-1850 | II, 3 | Intensive study of major interpretative works in European history. (Lec. 3) Prerequisite: graduate or senior standing, permission of department. Staff | |
| 439 Emergence of Industrial America, 1877-1917 | I, 3 | 515 Seminar in Twentieth-Century Diplomacy | II, 3 |
| 440 United States History from 1917 to 1945 | I or II, 3 | Research in the history of international relations since 1900. (Lec. 3) Prerequisite: HIS 410 or 411 or permission of department. In alternate years, next offered spring 1974. Thomas | |
| 441 United States History since 1945 | I or II, 3 | 521, 522 Readings and Research in European History | I and II, 3 each |
| 442 Social and Intellectual History of the United States to 1865 | I, 3 | Intensive study of selected topics in European history. With permission of the department, this course may be taken twice for credit. (Lec. 3) Prerequisite: graduate or senior standing, permission of department. Staff | |
| 443 Social and Intellectual History of the United States, 1865 to the Present | II, 3 | 535 Colloquium in American History | I or II, 3 |
| 445 History of the Negro Peoples | II, 3 | Intensive study of major interpretative works in American history. (Lec. 3) Prerequisite: graduate or senior standing, permission of department. Staff | |
| 448 American Social Reform | II, 3 | 540 Seminar in American Colonial History: The Seventeenth and Eighteenth Centuries | I or II, 3 |
| 450 Constitutional History of the United States | II, 3 | Intensive research on selected topics in the Colonial period of American history. (Lec. 3) Prerequisite: permission of department. Staff | |
| 453 United States Diplomatic History to 1914 | I, 3 | 541 Seminar in Nineteenth-Century American History | I and II, 3 |
| 454 United States Diplomacy in the Twentieth Century | II, 3 | Intensive research on selected topics in the broad period between adoption of the Constitution and World War I. (Lec. 3) Prerequisite: permission of department. Staff | |
| 457 History of Religion in the United States | I, 3 | 542 Seminar in Twentieth-Century United States History | I and II, 3 |
| 462 History of Rhode Island | II, 3 | Intensive research on selected topics in United States history since 1900. (Lec. 3) Prerequisite: permission of department. Staff | |
| 465 The Civil War in America | I, 3 | 543 Seminar in the History of the United States, Foreign Relations | II, 3 |
| 466 Reconstruction in America | II, 3 | Research in the history of U.S. foreign relations since 1775. All aspects of foreign relations, including both internal and external factors and historiographical problems will be considered. (Lec. 3) Prerequisite: HIS 452 or permission of department. Staff | |
| 469 The Protestant and Catholic Reformation I | I, 3 | 550 Seminar in Black Nationalism and the International Race Problem | I or II, 3 |
| 470 The Protestant and Catholic Reformation II | II, 3 | Examination of the historical roots of black nationalism in the United States and the international impli- | |
| 471 History of the Far East: Classical Period | I, 3 | | |
| 472 History of the Far East: Modern Period | II, 3 | | |
| 473 History of Modern China | II, 3 | | |
| 474 History of Modern Japan | I, 3 | | |
| 477 Southwest Asia and North Africa since 1683 | II, 3 | | |
| 479 Imperialism and Its Impact upon Colonized Peoples | I, 3 | | |

cations of racial conflicts in selected areas of the world. (Lec. 3) *Prerequisite: permission of instructor.* Weisbord

573
560 Research in Local History II, 3
 Directed research in secondary and primary materials on topics of interest to the individual. (Lec. 3) *Prerequisite: HIS 141 and 142.* Metz

573
580 Colloquium in Latin-American History I or II, 3
 Intensive study of major interpretative works in Latin-American history. (Lec. 3) Bryan

573
591 Directed Study or Research I and II, 3
 Directed readings, research, or study designed to meet the particular needs of individuals or small groups of graduate students. Staff

573
593 Seminar in Historical Studies I and II, 3
 Advanced study in the major literature of American or European history. Emphasis placed upon problems of historiography and historical criticism. (Lec. 3) *Prerequisite: permission of department.* Staff

599 Masters Thesis Research I and II
 Number of credits is determined each semester in consultation with the major professor or program committee.

HOME MANAGEMENT (HMG)

401 Home Management Problems of Deprived Families II, 3

470 Special Problems in Home Management I and II, 2-4

569
570 Special Problems in Home Management I, 3
 Advanced study to be selected from areas of home management theory and its application, work simplification, family economics and equipment. (Lab. TBA) Staff

567
575 Presentation of Home Management Principles II, 3
 Special problems in presenting principles of home management at the secondary level, the college level, and in adult education. (Lec. 3) Staff

INDUSTRIAL ENGINEERING (IDE)

404 Engineering Economy I, 3

411 Engineering Statistics I I, 3

412 Engineering Statistics II II, 3

422 Production Facilities Design II, 3

430 Design and Analysis of Compensation Systems II, 3

432 Operations Research I I, 3

433 Operations Research II II, 3

440 Materials Processing and Metrology I II, 3

491, 492 Special Problems I and II, 1-6 each

500 Network Application in Industrial Engineering II, 3

Industrial system problems that can be formulated in terms of flows in networks. Critical path scheduling, transportation problems, allocation, sequencing, and line balancing are some of the topics to be considered. (Lec. 3) *Prerequisite: IDE 432 and permission of instructor.* In alternate years. Shao

510 Human Factors II, 3
 Analytic relationships between man and his working environment. The design of equipment, facilities and environmental controls to meet the capabilities and limitations of the human being. (Lec. 3) *Prerequisite: permission of instructor.* Rubinsky

513 Statistical Quality Control I, 3
 Topics in statistical quality control systems. Single, multiple, and sequential sampling. Design and analysis of a wide variety of statistical control systems used in conjunction with discrete and continuous data, for several kinds of data emission. (Lec. 3) *Prerequisite: IDE 412 or equivalent.* Nichols

517 Applied Control Theory in Industrial Engineering I, 3

Complex control mechanisms will be studied and applied to production and manufacturing operation. Automatic control systems for production and manufacturing will be designed and analyzed. (Lec. 3) *Prerequisite: IDE 404, MTH 244 and permission of instructor.* Staff

520 Material Handling I, 3
 Development of principles for the engineering design and evaluation of equipment to move industrial materials in and between processes, including the chemical and physical characteristics of the material to be handled, rates of material flow, queuing and economics. (Lec. 3) *Prerequisite: MCE 263, CVE 220, IDE 404.* Rubinsky

525 Simulation
 See Computer Science 525.

533 Advanced Statistical Methods for Research and Industry I, 3

Estimation and testing; regression and correlation; analysis of variance and related topics. Applications in industrial operations and engineering research. (Lec. 3) *Prerequisite: IDE 411 or permission of instructor.* James

535 Industrial Reliability Engineering II, 3
 Theories of reliability applicable to the design and

operations of manufacturing processes and product quality assurance control systems. Quantitative analyses of economic specifications, performance levels, maintenance levels, and redundancy systems. (Lec. 3) *Prerequisite: permission of instructor.* Nichols

540 Production Control and Inventory Systems I, 3
Theory and practice of industrial production control and inventory systems. A broad spectrum of mathematical models for static, dynamic, perpetual, and periodic inventory systems as they affect and relate to production. (Lec. 3) *Prerequisite: permission of instructor.* Staff

541 Materials Processing and Metrology II I, 3
Continuation of IDE 440. Engineering analyses in the processing of materials. A detailed study of dynamic coupling, tool-workpiece interaction, energy and thermal analysis; mechanics of material removal and displacements, advanced topics in mechanical electrical systems for processing of materials. (Lec. 3) *Prerequisite: IDE 440 or permission of instructor.* Staff

550, 551 Advanced Topics in Probabilistic Operations Research I and II I and II, 3 each
Concepts of simple random processes and their application in the analysis of industrial problems. Random walk, branching processes, recurrent events, discrete and continuous Markov chains, birth and death models and their application to inventory, replacement, reliability, and waiting line problems. (Lec. 3) *Prerequisite: IDE 411, MTH 215, or equivalent.* Branson

555 Engineering Applications of Mathematical Programming I I, 3
Sensitivity analysis and pricing problems, practical cal problems in degeneracy and duality, decomposition methods for large-scale systems, applied convex, integer, nonlinear and quadratic programming methods. An introduction to stochastic programming. (Lec. 3) *Prerequisite: IDE 432 and permission of instructor.* Staff

556 Engineering Applications of Mathematical Programming II II, 3
Continuation of IDE 555. (Lec. 3) *Prerequisite: IDE 555 and permission of instructor.* In alternate years. Staff

560 Process Engineering II, 3
Design and selection of processes, equipment, instrumentation and production sequence for efficient and economic manufacture of products through mathematical analyses of physical and economic principles. (Lec. 3) *Prerequisite: IDE 330, 404.* Staff

565 Theory of Scheduling II, 3
Sequencing problems, finite sequencing for a single machine, n/m job shop problems with analytical and heuristic procedures, networks applied to scheduling, queuing systems in scheduling, probabilistic schedul-

ing problems. Survey of selected literature. (Lec. 3) *Prerequisite: permission of instructor.* In alternate years, next offered 1973-74. Shao

591, 592 Special Problems I and II, 1-6 each
Advanced work under supervision of a member of the staff and arranged to suit the individual requirements of the student. (Lec. or Lab. according to the nature of the problem) Credits not to exceed a total of 12. *Prerequisite: permission of department.* Staff

599 Masters Thesis Research I and II
Number of credits is determined each semester in consultation with the major professor or program committee.

610 Topics in Applied Queuing Theory I, 3
Poisson and Erlang queues, imbedded chains, M/G/1 and G/M/1 queues, and related topics in queuing theory. Analysis of a wide variety of queues with an applications orientation. (Lec. 3) *Prerequisite: IDE 433 or permission of instructor.* In alternate years, next offered 1973-74. Branson

634 Design and Analysis of Industrial Experiments II, 3
Further development of topics in analysis of variance. Randomized blocks, Latin squares and related designs, factorial experiments, confounding and fractional replications, and split-plot designs. Design and analyses of engineering experiments. (Lec. 3) *Prerequisite: IDE 533.* Lawing

635 (or EST 635) Response Surfaces and Evolutionary Operations II, 3
Methods of determining the response surface for multiple factors over a specified range and techniques for seeking an optimum. First and second order response surfaces. Rotatable second order design. Central composite rotatable designs. Multivariable EVOP programs and other topics in evolutionary operations. (Lec. 3) *Prerequisite: IDE 533 or equivalent.* Lawing

641 Molecular Aspects of Materials Processing
See Chemical Engineering 637.

642 Advanced Topics in the Processing of Materials I I or II, 3
Extensive studies of contemporary and classical research in metallic materials processing. Systems study of problems of processing modern materials and the technological achievements in processing. (Lec. 3) *Prerequisite: IDE 541 or permission of instructor.* In alternate years, next offered 1973-74. Staff

643 Advanced Topics in the Processing of Materials II I or II, 3
Extensive studies of contemporary and classical research in non-metallic materials processing. Systems study of problems of processing modern materials and the technological achievements in processing. (Lec. 3) *Prerequisite: IDE 541 or permission of instructor.* In alternate years. Staff

369

645 Manufacturing Engineering: Design, Analysis, Synthesis *II, 4*

Consideration of production and logistic systems, quantitative models introduced in and applied to congestion problems, industrial planning, behavioral theory, control, scheduling, and other problem areas of the industrial enterprise. (*Lec. 4*) *Prerequisite: permission of instructor.* Staff

new 72

657 Geometric and Dynamic Programming *II, 3*

Basic concepts of geometric programming, the duality theorem, approximation and limiting techniques. Nature of dynamic programming, deterministic and stochastic sequential decision problems. Lagrange multipliers in both geometric and dynamic programming. (*Lec. 3*) *Prerequisite: IDE 555. In alternate years, next offered 1973-74.* Shao

660 Methods of Optimization *II, 3*

Methods of optimization: indirect, direct elimination, climbing. Geometric programming. Problems and other topics in applied optimization. (*Lec. 3*) *Prerequisite: CSC 500 and permission of instructor. In alternate years, next offered 1973-74.* Staff

571

691, 692 Advanced Special Problems in Industrial Engineering *I and II, 1-6 each*

Advanced work under the supervision of a member of the staff and arranged to suit the individual requirements of the student. (*Lec. or Lab. according to nature of problems*) *Credits not to exceed a total of 12. Prerequisite: permission of department.* Staff

new 72-73

INSURANCE (INS)**560 Management of Insurance Enterprises** *I, 3*

Functional analysis of the operations and problems of stock and mutual insurance organizations in the life, property, and liability insurance industry. Emphasis is upon legal organization, management and control, and financial management of insurers. (*Lec. 3*) *Prerequisite: permission of instructor.* Staff

new 72-73

570 Risk Management *II, 3*

Analysis of nature of risk, the identification, measurement and control of pure risk within firm and society. Teaching methodology includes lectures, group discussion and analysis of case problems. (*Lec. 3*) *Prerequisite: permission of instructor.* Staff

ITALIAN (ITL)**409, 410 History of the Italian Language***I and II, 3 each***411, 412 Italian Literature of the Middle Ages***I and II, 3 each***421, 422 Italian Literature of the Renaissance***I and II, 3 each***431 Italian Literature of the Seventeenth Century** *I, 3***442 Italian Literature of the Eighteenth Century** *II, 3***451, 452 Italian Literature of the Nineteenth Century** *I and II, 3 each***461, 462 Italian Literature of the Twentieth Century** *I and II, 3 each***481, 482 La Divina Commedia** *I and II, 3 each***497, 498 Directed Study** *I and II, 3 each***JOURNALISM (JOR)****434 (433) Contemporary Issues in Mass Communication** *I, 3***435 Theory of Communication** *I, 3***436 Fundamentals of Communication Research** *II, 3***438 Governmental and Legal Aspects of Mass Communication** *I, 3***440 Criticism, Opinion and Interpretation in the Mass Media** *II, 3***441 International Communications** *I, 3***442 Independent Study and Projects in Mass Communications** *I and II, 1-3***443 Mass Communication Media in Africa** *II, 3***452 Public Relations Principles and Publications** *I, 3***LATIN (LAT)****497, 498 Directed Study** *I and II, 3 each***LIBRARY SCIENCE (LSC)****500 Introduction to Libraries and Librarianship** *I and II, 3*

Overview of the field covering the language and literature of librarianship, the history and functions of libraries, the nature of the various types of libraries, the library profession, and library operations. (*Lec. 3*) Bergen and Staff

502 Library Administration *I and II, 3*

Libraries and their governing agencies, scientific management principles, organization and operation of library departments, personnel problems and procedures, budget preparation, statistics, and quarters and planning. (*Lec. 3*) Bohnert or Healey

- 503 Selection of Library Materials** *I and II, 3*
Study of and practice in using the principles involved in the selection of books and nonbook materials for collections of all types of libraries. (Lec. 3) Tryon
- 504 Basic Reference** *I and II, 3*
Practical experience in the use of basic reference materials, with readings and discussion of the philosophy and administrative aspects of reference work. (Lec. 3) Schneider
- 505 Cataloging and Classification** *I and II, 3*
Introduction to the principles and practice of descriptive and subject cataloging and classification using the Dewey Decimal classification and Sears subject headings, with an introduction to the Library of Congress classification. Emphasis is on books and book-like materials. (Lec. 3) Chin
- 506 Technical Services** *I and II, 3*
Principles and policies employed in the acquisition, organization, conservation, and circulation of book and nonbook materials in libraries of various kinds. (Lec. 3) Chin
- 510 History of Books and Printing** *I or II, 3*
Western civilization as affected by the book arts and the extension of culture through the printed book, with stress on literary property and censorship as related to printing and libraries. (Lec. 3) Tryon
- 511 Comparative Librarianship** *I and II, 3*
The practice of librarianship in selected countries, including the social, economic, and political factors influencing its development, with consideration of the role of cooperation among international organizations. (Lec. 3) Bergen
- 512 History of Libraries and Librarianship** *I or II, 3*
Development of libraries and librarianship within a cultural, social, and economic context, from ancient times to the present. Western civilization will be emphasized. (Lec. 3) Bergen
- 513 Intellectual Freedom and Censorship** *I or II, 3*
Historical development and current status of the concept of intellectual freedom and the restraints that past and present societies have imposed on it. Special attention given the librarian's role in defense of intellectual freedom. (Lec. 3) Tryon
- 514 (501) The Library in Society** *I, 3*
Character and function of the library as a social agency, with special attention to the philosophies of contemporary librarianship. (Lec. 3) Bergen
- 520 The School Library** *I and II, 3*
The school library in relation to the school curriculum, other community library resources, and extracurricular needs of the students. Special problems in the selection of materials, budgets, and standards for the library as a materials center with an active part in the teaching function of the school. (Lec. 3) *Prerequisite: LSC 502.* Salvatore
- 521 Public Library Service** *I or II, 3*
Reading on and discussion of the backgrounds, aims, and problems of the American public library, with particular attention to larger unit systems. (Lec. 3) *Prerequisite: LSC 502.* Healey
- 522 College and University Library Service** *I or II, 3*
Philosophic and practical considerations implicit in the functions, organization, and management of college and university libraries as these differ from other types of libraries. (Lec. 3) *Prerequisite: LSC 502.* Tryon
- 523 Special Library Service** *I or II, 3*
Organization, management, and regular and special procedures as they apply to special libraries, with particular emphasis upon standards and planning for space and equipment. (Lec. 3) *Prerequisite: LSC 502.* Bohner or Chin
- 526 Automation in Libraries** *I or II, 3*
The application of technology and systems analysis to the operation of various types of libraries. (Lec. 3) *Prerequisite: permission of instructor.* Healey
- 527 Seminar in Library Administration** *I and II, 3*
Intensive study of selected problems in important areas of library administration by means of discussion, readings, special lectures, and the presentation of papers based on literature surveys or research. (Lec. 3) *Prerequisite: permission of instructor.* Healey
- 528 Multi-Media and the Library** *I and II, 3*
The role of A-V materials in media centers and other types of libraries. (Lec. 3) *Prerequisite: LSC 520.* Salvatore
- 529 Library Cooperation** *II, 3*
Library cooperation including the development of library systems, the role of government in the development of such systems, and the problems inherent in the development of cooperation. (Lec. 3) Healey
- 530 Reading Interests of Children** *I or II, 3*
Survey of the development of children's literature, with analysis of current trends in publication, the limited-vocabulary book at beginning and advanced levels, and the significance of illustrations for the reading process. Fiction considered but main emphasis on informational books as recreational reading. (Lec. 3) *Prerequisite: LSC 503.* Salvatore
- 531 Reading Interests of Adolescents** *I or II, 3*
Materials of special interest to high school students in school and public libraries, stressing nonfiction but including fiction for the age group and for adults and the responsibility of the library in the drop-out problem. (Lec. 3) *Prerequisite: LSC 503.* Salvatore
- 532 Reading Interests of Adults** *I or II, 3*
Examination of the range and depth of books as a

source of appeal to adults with emphasis on reading, annotations, and discussion to develop critical faculties. (Lec. 3) Tryon

- 533 Children's Library Materials** *I and II, 3*
Books and related library materials in the area of creative literature for children: history, bibliography, selection, evaluation, and presentation. (Lec. 3) *Prerequisite: LSC 503.* Salvatore

536 Storytelling *I, 3*
Selection, adaptation, and presentation of stories for children of all ages, including attention to sources of materials, planning the story hour, and training and practice in the art of storytelling. (Lec. 3) Staff

- 540 Library Materials in the Humanities** *I and II, 3*
Important library resources in the humanities, including the major works, serial publications, and reference and bibliographical materials thereof. (Lec. 3) *Prerequisite: LSC 504.* Schneider

- 541 Library Materials in the Social Sciences** *I and II, 3*
Important library resources in the social sciences, including the major works, serial publications, and reference and bibliographical materials thereof. (Lec. 3) *Prerequisite: LSC 504.* Bergen or Schneider

- 542 Library Materials in Science and Technology** *I and II, 3*
Important resources in science and technology including the major works, serial publications, and reference and bibliographical materials thereof. (Lec. 3) *Prerequisite: LSC 504.* Bohnert or Chin

- 543 Government Publications** *I or II, 3*
Survey of the publishing activities and publications of national, state, and local governments with emphasis on the publications of the United States government. (Lec. 3) *Prerequisite: LSC 504.* Schneider

- 544 Information Science for Librarians** *I or II, 3*
Introduction to information storage and retrieval (analysis, semantics, thesaurus building, and data banks and their implications) as it applies to librarianship. (Lec. 3) Bohnert

- 545 Technical Information Centers** *I and II, 3*
New technical information centers which provide publication, consultant, and question-answering services, emphasizing the differences between them and technical libraries and professional societies. (Lec. 3) *Prerequisite: permission of instructor.* Bohnert

- 550 Advanced Cataloging** *I or II, 3*
Theory and problems in descriptive and subject cataloging. Comparative analysis of different classification schemes with emphasis on the use of Library of Congress classification and subject headings. Includes organization of non-book materials. (Lec. 3) *Prerequisite: LSC 505.* Chin

- 560 Research in Librarianship** *I or II, 3*
Methods of investigating problems in library science

and an introduction to and evaluation of the literature of the field. (Lec. 3) *Prerequisite: permission of instructor.* Humeston or Bohnert

591, 592, 593 Independent Work

By Appt., 1-3 respectively

Supervised reading or investigation in areas of special interest to students who obtain written approval for such study prior to registration for the semester for which it is proposed. *Prerequisite: 18 hours of library science with a B average.* Staff

LINGUISTICS (LIN)

- 409, 410 Introduction to the Study of Language**
I and II, 3 each

- 431 Applied Linguistics in the Language Laboratory**
I, 1

The following are related, specialized courses in historical linguistics offered in the Departments of English and Languages.

ENG 530 History of the English Language
FRN 503, 504 History of the French Language
GER 409 History of the German Language
ITL 409, 410 History of the Italian Language
SPA 409 History of the Spanish Language

MANAGEMENT SCIENCE (MGS)

- 445 (457) Managerial Applications of Simulation** *I, 3*

- 458 Advanced Production Management** *II, 3*

- 476 Management System Analysis** *II, 3*

- 491, 492 Special Problems** *I and II, 3 each*

- 579 (979) Computing in Management** *I, 2*
Computer concepts and programming in a high level language such as BASIC, FORTRAN, PL/1. Assigned problems emphasize the use of computing as an administrative and analytical tool for applications in management. (Lec. 2) Staff

- 580 (980) Quantitative Methods for Management Analysis** *I and II, 3*
Mathematical tools useful to managers. Depth coverage given to differential and integral calculus, vectors and matrices. (Lec. 3) Staff

- 581 (981) Management Statistics** *I and II, 3*
Statistical methods as tools of management; the collection and interpretation of data; statistical inference and decision-making; regression and correlation. (Lec. 3) Staff

- 585 (985) Production and Operations Management** *I, 2*
Concepts and problems associated with the design

and development of systems for the creation of products and services. (Lec. 2) Staff

601, 602 (501, 502) Advanced Management Statistics *I and II, 3 each*

Theory and application of regression and correlation analysis, analysis of variance and experimental design, and other multivariate data analyses. (Lec. 3) *Prerequisite: MGS 581 or permission of instructor.* Staff

663 Management Information Systems *II, 3*
 Concepts and problems associated with the design, implementation, and management of information systems. (Lec. 3) *Prerequisite: MGS 579, equivalent or permission of instructor.* Staff

681 Advanced Operations Management *II, 3*
 Problems facing the manager of production and other business processes which are devoted to the creation of capital as well as consumer goods and services are examined and analyzed, employing modern decision-making techniques. (Lec. 3) *Prerequisite: MGS 581 and 585 or permission of instructor.* Vollmann and Zartler

682 Quantitative Management Analytical Techniques *I and II, 3*
 Development and application of the principal mathematical and statistical techniques used in model building and decision-making under certainty and uncertainty. (Lec. 3) *Prerequisite: MGS 581 or permission of instructor.* Jarrett, Shen and Shih

683 Business Decision Theory *I, 3*
 A statistical analysis of managerial decision-making under uncertainty. Bayesian statistical inference and subjective probability are stressed. Comparisons between Bayesian method and classical statistics are discussed and applications to business problems are emphasized. (Lec. 3) *Prerequisite: MGS 580, 581 or equivalent.* Jarrett

684 Advanced Programming Methods in Management Decisions *II, 3*
 Introduction to nonlinear and dynamic programming. Emphasis on application of modern mathematical optimization techniques in single-stage and multiple-stage management decision problems. Management applications of the Kuhn-Tucker theorem, quadratic programming, geometric programming, convex programming, integer programming, and dynamic programming. (Lec. 3) *Prerequisite: MGS 580 and 682 or equivalent.* Jarrett

MARINE AFFAIRS (MAF)

521 Coastal Zone Law *II, 3*
 Examination of the authority of different levels and agencies of government to make decisions affecting coastal regions. Survey of existing and proposed state

and national legislation affecting coastal regions. (Lec. 3) Cameron

651, 652 Marine Affairs Seminar *I and II, 3 each*
 Interdisciplinary seminar conducted by Marine Affairs Program faculty supplemented by guest speakers from industry and government. Focuses on problems of marine resources development and management at the local/state, national and international policy levels. (Lec. 3) *Prerequisite: permission of director.* Alexander, Gamble and Cameron

MARKETING MANAGEMENT (MMG)

443 Retail Store Management *I, 3*

452 International Marketing *II, 3*

462 Marketing Research *II, 3*

464 Marketing Policy and Problems *II, 3*

466 Quantitative Marketing Management *II, 3*

474 Advertising Seminar *I, 3*

475 Advertising Campaigns *II, 3*

481, 482 Directed Study *I and II, 3 each*

550 (950) Marketing Theory and Practice *I and II, 2*
 Analytical approach to contemporary theory and practice of marketing management. (Lec. 2) Staff

651 Marketing Management *I and II, 3*
 Analysis of marketing problems and determination of marketing policies in product development, promotion, pricing, channel selection; legal aspects. (Lec. 3) *Prerequisite: MMG 550 or equivalent.* Staff

656 International Marketing Management *I and II, 3*
 Marketing policy-making for the multinational firm; organizing for international marketing; its opportunities, pricing, channels, promotion, research. (Lec. 3) *Prerequisite: MMG 550 and 651.* Staff

658, 659 Seminar in Marketing *I and II, 3 each*
 Preparation and presentation of papers on selected topics in marketing. (Lec. 3) *Prerequisite: MMG 550, 651, or permission of instructor.* Staff

MATHEMATICS (MTH)

418 Matrix Analysis *II, 3*

423 Introduction to Differential Geometry *I, 3*

425 Topology *I, 3*

441 Introduction to Partial Differential Equations *I, 3*

- 442 Vector and Tensor Analysis** *II, 3* **F12**
- 444 Ordinary Differential Equations** *II, 3*
- 451 Introduction to Probability and Statistics** *I, 3*
- 452 Mathematical Statistics** *II, 3*
- 456 Probability** *II, 3*
- 461 Methods of Applied Mathematics** *I, 3*
- 462 Functions of a Complex Variable** *I and II, 3*
- 471 (373) Numerical Methods of Programming** *I and II, 3*
- 472 Introduction to Numerical Analysis** *I, 3*
- 492 Special Problems** *I and II, 1-3*
- 513 Linear Algebra** *I or II, 3*
Linear spaces and transformations, linear functionals, adjoints, projections, diagonalization, Jordan form of matrices, inner products; positive, normal, self adjoint and unitary operators; spectral theorem, bilinear and quadratic forms. (Lec. 3) Staff
- 515, 516 Algebra I, II** *I and II, 3 each*
Groups, rings, modules, commutative algebra. (Lec. 3) Prerequisite: MTH 316. Staff
- 525 Topology I** *I, 3*
Topological spaces, separation properties, connectedness, compactness, uniformities. Function spaces, spaces of continuous functions and complete spaces. (Lec. 3) Prerequisite: MTH 425 or equivalent. Staff
- 526 Topology II** *II, 3*
Homotopy. Fiberspaces. Homology and cohomology. Notions of homological algebra. Products. (Lec. 3) Prerequisite: MTH 525. Staff
- 535, 536 Measure Theory and Integration** *I and II, 3 each*
Elements of topology and linear analysis. Lebesgue measure and integration in \mathbb{R} , in \mathbb{R}^n , and in abstract spaces. Convergence theorems. Bounded variation, absolute continuity, and differentiation. Lebesgue-Stieltjes integral. Fubini and Tonelli theorems. The classical Banach spaces. (Lec. 3) Prerequisite: MTH 336. Staff
- 545, 546 Ordinary Differential Equations I, II** *I and II, 3 each*
Existence and uniqueness theorems. Continuous dependence on parameters and initial conditions. Singularities of the first and second kinds, self-adjoint eigenvalue problems on a finite interval. Oscillation and comparison theorems. Elements of asymptotic theory. Elements of stability theory of Lyapunov's second method. (Lec. 3) Prerequisite: MTH 335 and 462. Staff
- 550 Advanced Probability** *I, 3*
Investigation in depth of a topic in foundations or applications of modern probability theory. (Lec. 3) Prerequisite: MTH 456. Staff
- 551 Advanced Mathematical Statistics I** *I, 3*
A thorough development of classical and modern statistics: sampling theory, asymptotic sampling, theory for large samples and exact sampling distributions. The theory of estimation including unbiased estimates, consistent estimates, sufficient statistics, non-parametric and parametric statistics and multidimensional confidence regions. Utility of the theory illustrated by applications from various fields. (Lec. 3) Prerequisite: MTH 452, 335, or permission of instructor. MTH 335 may be taken concurrently. Staff
- 552 Advanced Mathematical Statistics II** *II, 3*
Continuation of MTH 551: tests of significance, sample hypothesis, composite hypothesis, most powerful tests, unbiased tests, analysis of variance, regression and multiple regression. Utility of the theory illustrated by applications from various fields. (Lec. 3) Prerequisite: MTH 551. Staff
- 561 Advanced Applied Mathematics** *II, 3*
Linear spaces, theory of operators, Green's functions, eigenvalue problems of ordinary differential equations. Application to partial differential equations. (Lec. 3) Prerequisite: MTH 461. Staff
- 562 Complex Function Theory** *I, 3*
Analytic continuation, Riemann surfaces. The theory of conformal mapping. Representation theorems and applications. Entire functions. (Lec. 3) Prerequisite: MTH 462. Staff
- 572 Numerical Analysis** *II, 3*
Further numerical methods of solution of simultaneous equations, partial differential equations, integral equations. Error analysis. (Lec. 3) Prerequisite: MTH 472. Staff
- 591, 592 Special Problems** *I and II, 1-3 each*
Advanced work, under the supervision of a member of the department and arranged to suit the individual requirements of the student. Prerequisite: permission of department. Staff
- 599 Masters Thesis Research** *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.
- 601 Seminar** *I and II, 3*
A graduate seminar in the field of specialization of a member of the department. Prerequisite: permission of department. Staff
- 629, 630 Functional Analysis I, II** *I and II, 3 each*
Banach and Hilbert spaces, basic theory. Bounded linear operators, spectral theory. Applications to analysis. Application to a special topic such as differ-

ential operators, semigroups and abstract differential equations, theory of distributions, or ergodic theory. (Lec. 3) *Prerequisite: MTH 536 and permission of instructor.* Staff

new 68 635, 636 **Selected Topics in Real Analysis I, II** *I and II, 3 each*
Advanced topics of current research in real analysis will be presented with a view to expose the students to the frontiers of the subject. (Lec. 3) *Prerequisite: permission of department.* Staff

F 641 **Partial Differential Equations I** *I, 3*
First order systems. The Cauchy-Kowalewsky theorem. The Cauchy problem. Classification of partial differential equations. Hyperbolic equations. Mainly the theory of the subject. Students interested in techniques for the solution of standard equations should take MTH 441. (Lec. 3) *Prerequisite: MTH 215, 335, and 462.* Staff

5 72 642 **Partial Differential Equations II** *II, 3*
Elements of potential theory. Elliptic equations. Green's function. Parabolic equations. Introduction to the theory of distributions. (Lec. 3) *Prerequisite: MTH 641.* Staff

F 71 645, 646 **Selected Topics in Differential Equations I, II** *I and II, 3 each*
Advanced topics of current research in differential equations will be presented with a view to expose the students to the frontiers of the subject. (Lec. 3) *Prerequisite: permission of department.* Staff

new 68 659, 660 **Selected Topics in Applied Mathematics I, II** *I and II, 3 each*
Advanced topics of current research in applied mathematics will be presented with a view to expose the students to the frontiers of the subject. (Lec. 3) *Prerequisite: permission of department.* Staff

F 72 691, 692 **Special Topics I, II** *I and II, 3 each*
Advanced topics of current research in mathematics will be presented with a view to expose the students to the frontiers of the subject. (Lec. 3) *Prerequisite: permission of department.* Staff

F 5 699 **Doctoral Dissertation Research** *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

new 68 901 **Mathematics Colloquium** *I and II, 0*
Current topics in various fields of mathematics, given by special lecturers. *Prerequisite: permission of department.* Staff

MECHANICAL ENGINEERING AND APPLIED MECHANICS (MCE)

417 (or EIE 417) **Direct Energy Conversion** *II, 3*
423 **Design of Machine Elements** *I, 3*

424 **Dynamics of Machines** *I, 3*

425 **Lubrication and Bearings** *I, 3*

426 **Advanced Mechanics of Materials** *II, 3*

427 (or ZOO 427) **Modelling and Analysis of Dynamic Systems** *I, 3*

428 **Mechanical Control Systems** *II, 3*

429 **Comprehensive Design** *II, 3*

437 **Rocket Propulsion** *II, 3*

438 **Internal Combustion Engines** *I, 3*

439 **Applied Energy Conversion** *II, 3*

448 **Heat and Mass Transfer** *I, 3*

455 **Advanced Fluid Mechanics** *I, 3*

457 (or OCE 457) **Fluidics** *II, 3*

463 **Intermediate Dynamics** *I, 3*

464 **Vibrations** *II, 3*

491, 492 **Special Problems** *I and II, 1-6 each*

501, 502 **Graduate Seminar** *I and II, 1 each*
Participation in seminar discussions, presentation of papers based on research or detailed literature surveys. Attendance is required of all students in graduate residence. A maximum of 1 credit per year is allowed and no more than 2 credits are allowed for the entire period of residence. (Lec. 1) Staff

5 73 503 **Linear Control Systems**
See Electrical Engineering 503.

new 72 73 515 (or CHE 515) **Combustion** *II, 3*
Combustion phenomena including chemical reactions and kinetics, ignition and quenching, flame propagation, detonation waves, propellant combustion; applications to heat engines, propulsion devices, the control of unwanted fires, and pollution due to combustion. (Lec. 3) *Prerequisite: MCE 342 and 354 or CHE 313 and 342 or 344 or equivalent.* Conta

F 72 517 (or ELE 517) **Magnetofluidmechanics** *I or II, 3*
Formulation of the basic concepts and equations governing the interaction between electromagnetic fields and a moving, electrically conducting, continuum fluid. Wave motions in MFM systems and engineering applications. (Lec. 3) *Prerequisite: MCE 455 and ELE 511 or PHY 431, or permission of instructor.* Lessmann

5 73 521 **Reliability Analysis and Prediction** *II, 3*
Statistical analysis of failure of complex engineering systems, design factors contributing to functional sys-

tem survival, failure, distribution functions, redundancy, confidence, reliability testing. (*Lec. 3*) *Prerequisite: MTH 451 or equivalent, MCE 423 or permission of instructor.* Nash

524 Advanced Kinematics and Linkage Design I, 3
Systematics of mechanisms and synthesis of linkage design. (*Lec. 3*) *Prerequisite: MCE 423.* Hatch

531 Underwater Power Systems
See Ocean Engineering 531.

532 Coastal Zone Power Plants
See Ocean Engineering 532.

540 Environmental Control in Ocean Engineering
See Ocean Engineering 540.

541 Thermodynamics I, 3
Advanced study of classical thermodynamics with emphasis on basic concepts, laws, and thermodynamic relations. (*Lec. 3*) *Prerequisite: MCE 341, 354.* Brown and Wilson

542 Statistical Thermodynamics II, 3
Irreversible thermodynamics, kinetic theory of gases, statistical thermodynamics and the development and application of the partition function. (*Lec. 3*) *Prerequisite: MCE 341.* Wilson

545 Heat Transfer I, 3
Conduction in two and three dimensions and conducting systems with radiation and fluid motion. Solutions obtained by mathematics, computer-numerical methods, and analog devices. (*Lec. 3*) *Prerequisite: MCE 448.* Schenck

546 Convection Heat Transfer II, 3
Study of the relationship between heat transfer and fluid flow with emphasis on the solution of governing equations by exact methods, integral methods and similarity techniques. (*Lec. 3*) *Prerequisite: MCE 448.* Test

550 Theory of Continuous Media I, 3
Basic course for first-year graduate students which develops and unifies the laws of mechanics as applied to the behavior of continua. Application to solids and fluids. (*Lec. 3*) *Prerequisite: CVE 220, MCE 354, 372, or permission of instructor.* Dowdell and Kim

551 Fluid Mechanics I I, 3
A basic treatment of real fluid flows using the continuum approach. Solutions of the fundamental system of equations with and without temperature variations. (*Lec. 3*) *Prerequisite: MCE 354 or its equivalent.* Dowdell, Hagist and White

552 Fluid Mechanics II II, 3
A continuation of MCE 551 including incompressible irrotational flow, laminar and turbulent shear flows and other special topics of current interest. (*Lec. 3*) *Prerequisite: MCE 551.* Dowdell, Hagist and White

553 (656) Flow of Compressible Fluids II, 3
Fundamental equations of compressible fluid flow. Solutions of these equations for subsonic, transonic, supersonic, and hypersonic velocities. (*Lec. 3*) *Prerequisite: MCE 551 or permission of instructor.* Staff

563 Advanced Dynamics I and II, 3
Dynamics of a system of particles, D'Alembert's principle and Lagrange's equations from an advanced point of view. Variational methods, non-conservative and non-holonomic systems; matrix-tensor specifications of rigid body motions, inertia tensor, tops and gyroscopes. General theory of small oscillations of a system of particles, normal coordinates. Hamilton's equation of motion, canonical transformation, Hamilton-Jacobi theory. (*Lec. 3*) *Prerequisite: MCE 463 or permission of instructor.* Velletri and Nash

564 Advanced Vibrations I, 3
Theory of vibration of systems with concentrated masses and stiffness; systems with one degree of freedom, vibration isolation systems with many degrees of freedom, matrix methods, dynamic vibration absorbers, torsional vibration, approximate numerical methods and mobility and impedance methods. Experimental methods and design procedures. (*Lec. 3*) *Prerequisite: MCE 464.* Bradbury and Nash

565 Advanced Vibrations II, 3
Theory of vibration with continuously distributed mass and stiffness. Wave, characteristic function and integral equation methods of solution of string, longitudinal and torsional systems. Vibration and critical speeds of beams and rotating shafts, the methods of Rayleigh, Ritz, and Stodola, and self-excited vibrations. (*Lec. 3*) *Prerequisite: MCE 564.* Bradbury and Nash

572 Theory of Elasticity II, 3
Advanced theory of elasticity of isotropic and anisotropic bodies; plane stress and plane strain analysis via classical and Muskhelishvili's method, three-dimensional applications in torsion, bending, and semi-infinite solids. (*Lec. 3*) *Prerequisite: MCE 550 or permission of instructor.* Kim

573 Theory of Plates I and II, 3
Development of classical theory of plates and application to plates of various shapes under various loadings; buckling and large deflections. (*Lec. 3*) *Prerequisite: CVE 220, MTH 244, MCE 372, or permission of instructor.* Goff, Nash, and Staff

575 Elastic Stability I and II, 3
Stability analysis of bars under separate and combined axial, lateral, and torsional loadings; buckling of plates and shells, energy methods and numerical methods. (*Lec. 3*) *Prerequisite: CVE 220, MTH 244, MCE 372, or permission of instructor.* Goff

599 Masters Thesis Research I and II
Number of credits is determined each semester in

consultation with the major professor or program committee.

645 Boiling Heat Transfer and Two-phase Flow
See Chemical Engineering 645.

646 (or CHE 646) Radiation Heat Transfer I or II, 3
Radiant exchange between surfaces. Radiative properties of surfaces. Exchange among non-ideal surfaces. Gas-radiative exchange. Radiative exchange with volume emitters. Furnace design applications. (Lec. 3) *Prerequisite:* MCE 545 or CHE 644 or permission of instructor. Brown

654 Statistical Theories of Turbulence I, 3
Analytical description of random phenomena; three-dimensional space-time correlations. Theories of turbulence including anisotropy and non-homogeneity. Applications to meteorology, boundary layers, and turbulent diffusion. (Lec. 3) *Prerequisite:* MCE 552 or permission of instructor. Hagist

655 Viscous Compressible Flow II, 3
Flow of real fluids at extremely high speeds, with emphasis on the development of basic physical relations. Application to several problems in space technology. (Lec. 3) *Prerequisite:* MCE 541, 545, 551. Dowdell, Hagist, and White

666 Nonlinear Mechanics I and II, 3
Dynamics of nonlinear systems, free and forced oscillations; graphical methods, integral curves, singular points, limit cycles and stability. Van der Pol and Hill equations, perturbation methods, approximate methods of Duffing, Poincaré, Kryloff and Bogoliuboff. (Lec. 3) *Prerequisite:* MCE 564. Nash and White

673 Thermal Stress Analysis I, 3
Theory of stress and deformation in bodies subjected to thermal environments and restraints. Application to problems in thermoelasticity, thermal fatigue, thermoplasticity, and creep analysis. (Lec. 3) *Prerequisite:* MCE 448, 550. White and Kim

674 Theory of Shells I and II, 3
Development and application of membrane and bending theories of shells of various shapes. Variational methods and buckling of shells. (Lec. 3) *Prerequisite:* CVE 220, MCE 573, or permission of instructor. Kim

677 Fatigue Failure and Fracture Mechanics II, 3
Advanced study of fracture induced by repeated loading, damage theories, fundamental theories of microscopic crack initiation and growth, statistical aspects of fatigue failure, theory of crack propagation. (Lec. 3) *Prerequisite:* MTH 451, MCE 429, 550, or permission of instructor. Nash

679 Plasticity and Creep II, 3
Stress-induced flow of nominally solid materials, effect of temperature, combined stress problems; stress-de-

pendent creep of metals at elevated temperatures, creep buckling, anelastic creep, related dislocation theory. (Lec. 3) *Prerequisite:* MCE 550 or permission of instructor. Goff

691, 692 Special Problems I and II, 1-6 each
Advanced work, under the supervision of a member of the staff and arranged to suit the individual requirements of the student. (Lec. or Lab. according to nature of problem.) Credits not to exceed a total of 12. *Prerequisite:* permission of department. Staff

699 Doctoral Dissertation Research I and II
Number of credits is determined each semester in consultation with the major professor or program committee.

MEDICINAL CHEMISTRY (MCH)

443, 444 Organic Medicinal Chemistry I and II, 3 each

497, 498 Special Problems I and II, 1-5 each

501 Radiopharmaceuticals I, 3
The theoretical and applied aspects of the commonly used isotopes of pharmaceutical significance with emphasis on the diagnostic, therapeutic, and tracer applications in biological systems and techniques of development, formulation, quality control, and safe utilization. (Lec. 2, Lab. 3) *Prerequisite:* CHM 228 or PHY 112, or permission of department. Smith

526 Lipid Chemistry
See Food and Resource Chemistry 526.

533 Advanced Drug Assay I and II, 2-4
Advanced chemical and physical methods of analytical control related to pharmaceutical research and industrial pharmacy. (Lec. 1, Lab. 3-9) *Prerequisite:* MCH 342. Smith

548 (or PCG 548) Physical Methods of Identification II, 3
The utilization of physical methods (primarily spectroscopic) in the structure elucidation of complex organic molecules. Emphasis on interpretation of ultraviolet, infrared, nuclear magnetic resonance, mass and optical rotatory dispersion spectra. (Lec. 3) *Prerequisite:* CHM 425 and/or permission of instructor. Abushanab, Shimizu and Turcotte

549 Synthesis I and II, 3
Theoretical and applied aspects in synthesis of selected organic compounds of medicinal significance. (Lab. 9) *Prerequisite:* permission of department. Abushanab and Turcotte

599 Masters Thesis Research I and II
Number of credits is determined each semester in consultation with the major professor or program committee.

621, 622 Seminar *I and II, 1 each*
Seminar discussions including presentation of papers on selected topics in medicinal chemistry. (Lec. 1) Students attend seminar each semester while in graduate residence, but a maximum of 1 credit per year is allowed. No more than 3 credits allowed for the entire period of residence. Staff

643 Advanced Organic Medicinal Chemistry *II, 3*
Synthesis, modes of action, and effects on pharmacological activity. Analgesics, cholinergics, folic acid antagonists, diuretics, and sulfonamides are included. (Lec. 3) *Prerequisite: CHM 421 and permission of instructor. In alternate years, next offered 1973-74.* Staff

646 Alkaloids *I, 3*
Advanced course dealing with proof of structure, synthesis, chemical properties and biological activity of various alkaloids. (Lec. 3) *Prerequisite: permission of department.* Abushanab

697, 698 Research in Medicinal Chemistry *I and II, 1-3 each*
Literature survey, laboratory work and a detailed research report on one or more assigned topics in medicinal chemistry. (Lab. 3-9) *Prerequisite: permission of department.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

MICROBIOLOGY (MIC)

401 Advanced Bacteriology *I, 4*

412 Food Microbiology *II, 3*

432 Pathogenic Bacteriology *II, 3*

491, 492 Research in Microbiology *I and II, 1-6 each*

495, 496 Seminar in Microbiology *I and II, 1 each*

533 Immunity and Serology *I, 3*
Various immune reactions, nature of antigens and antibodies, and formation and action of latter. (Lec. 2, Lab. 3) *Prerequisite: MIC 201 and 1 semester organic chemistry and senior standing.* Carpenter

541 Physiology of Bacteria *I, 4*
Bacterial structure and function, including growth, nutrition, environmental factors, metabolism, biosynthesis, and energy-yielding reactions. (Lec. 3, Lab. 3) *Prerequisite: MIC 201, 2 semesters of organic chemistry and 1 semester of biochemistry.* Wood

552 Microbial Genetics *II, 3*
Recent research on the mechanisms of mutation and genetic recombination, the process of DNA replica-

tion, the genetic code, and regulation of DNA, RNA, and protein synthesis in microorganisms. (Lec. 2, Lab. 3) *Prerequisite: MIC 201, BOT 352, and BCH 311.* Cohen

new 72-73
567 (or OCG 567) Marine Bacteriology
See Oceanography 567.

593, 594 The Literature of Bacteriology *I and II, 2 each*
Thorough study of original literature of some phase of bacteriology. Written abstracts or papers on assigned topics are discussed in weekly conferences with instructor. (Lec. 1-2) Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

621 Systematic Bacteriology *I, 4*
Conferences, assigned readings, and laboratory work designed to give a knowledge of principles of classification of bacteria as well as methods of identifying and describing unknown species. (Lec. 3, Lab. 3) *Prerequisite: MIC 432 and either MIC 412 or 533. In alternate years, next offered 1973-74.* Houston

691, 692 Research in Microbiology *I and II, 3 each*
Assigned research on an advanced level. Student required to outline problem, conduct the necessary literature survey and experimental work, and present his observations and conclusions in a report. (Lab. 6) *Prerequisite: graduate standing.* Staff

695, 696 Graduate Research Seminar *I and II, 1 each*
Reports of research in progress or completed. (Lec. 1) *Required of all graduate students in microbiology.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

Note: for Virology, see Animal Pathology and Plant Pathology; for Mycology, see Botany.

MUSIC (MUS)

407 The Symphony *II, 3*

408 The Opera *II, 3*

418 Composition *II, 3*

419 Composition *I, 2*

420 Counterpoint *II, 3*

422 Advanced Orchestration *II, 2*

427, 428 Sixteenth-Century Counterpoint*I and II, 2 each***431 The Baroque Era***I and II, 3***432 The Classical Era***II, 3***433 The Romantic Era***I, 3***441 Special Projects***I and II, 3***445 Music in the Elementary School***II, 3***446 Teaching General Music***II, 3***451 Applied Music as Minor or Elective***I and II, 1-2 each***461 Applied Music Major***I and II, 4 each***481, 482 Piano Literature and Pedagogy***I and II, 2 each***539 Advanced Principles of Music Education I** *I, 3*

Study and analysis of philosophical, psychological, and historical foundations of music education. Development and significance of objectives and principles of music education in the United States. (Lec. 3) *Prerequisite: graduate standing in music.* Motycka

540 Advanced Principles of Music Education II *II, 3*

Critical study of principles of objectives, program, method, administration, supervision, and evaluation of music education in the United States. (Lec. 3) *Prerequisite: MUS 539.* Motycka

545 Musical Aptitude and Achievement *I, 3*

Intensive analysis of musical aptitude and achievement, from a thorough examination of existing devices to the consequent realization of research data via basic statistical concepts. (Lec. 3) *Prerequisite: graduate standing in music, EDC 371 or PSY 434 or equivalent.* Motycka

548 Research in Music Education *II, 3*

Examination of research techniques as applied to the art of music. Familiarization with extant major project procedures and data in the research categories: historical, analytical, experimental, descriptive, and philosophical. (Lec. 3) *Prerequisite: MUS 545.* Motycka

551 Applied Music as Minor or Elective*I and II, 2 each*

Private instruction. One 40-minute lesson and scheduled practice hours each week. One level, one year, as prescribed in applied minor syllabi. (Studio 6) *Prerequisite: completion of applied minor in undergraduate upper division and permission of department.* Staff

Select area of instruction from the following and add to course number as MUS 551B, Piano:

| | | |
|---------------|-------------|-----------------|
| A Voice | H Bass Viol | Q French Horn |
| B Piano | J Flute | R Trombone |
| C Organ | K Oboe | S Baritone Horn |
| D Harpsichord | L Clarinet | T Tuba |
| E Violin | M Bassoon | U Percussion |
| F Viola | N Saxophone | V Guitar |
| G Violoncello | P Trumpet | |

NUCLEAR ENGINEERING (NUE)**538 (or CHE 538) Nuclear Metallurgy** *II, 3*

Metallic materials of particular interest in nuclear engineering. The production and physical metallurgy of uranium, thorium, the transuranium elements, and the rare earths; protection against corrosion, radiation damage. (Lec. 3) *Prerequisite: CHE 332.*

581 (or CHE 581) Introduction to Nuclear Engineering *I and II, 3*

Survey course to acquaint students with the field and to emphasize the special application of principles learned in the several specialized branches of engineering. Major topics considered are nuclear physics, problems in the design of reactor cores, materials of construction, instrumentation and control, and health physics. (Lec. 3) *Prerequisite: PHY 340 or 341.* Knickle

582 (or CHE 582) Radiological Health Physics *I, 3*

Fundamentals of health physics and radiation protection are covered. Calibration and use of survey and monitoring equipment are emphasized in the laboratory. (Lec. 2, Lab. 3) *Prerequisite: permission of instructor. In alternate years.* Rose

583 (or CHE 583) Nuclear Reactor Theory *II, 3*

Elementary theory of self-sustained nuclear reactors. Diffusion and slowing-down theory of neutrons and the determination of the critical size and homogeneous thermal reactors with and without reflectors. One-group, two-group and modified two-group approaches are emphasized. (Lec. 3) *Prerequisite: PHY 340 or 341.* Knickle

585 (or CHE 585) Measurements in Nuclear Engineering *I, 3*

Basic techniques used in measuring the interaction of radiation and matter. Principles of ionization chambers, proportional and Geiger-Mueller counters, scintillation counters as well as the related circuitry are presented. Laboratory work stresses a thorough familiarization with the use of these instruments. (Lec. 2, Lab. 3) *Prerequisite: PHY 340 or 341 or permission of department.* Rose

586 (or CHE 586) Nuclear Reactor Laboratory *II, 3*

Theoretical and experimental determination of reactor characteristics. Experimental equipment includes a neutron howitzer, a subcritical training reactor and a one megawatt swimming pool reactor. Digital and

analog computer facilities are utilized in calculations. (Lec. 1, Lab. 4) *Prerequisite:* NUE 585. Rose

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

682 (or CHE 682) Radiation Shielding *II, 3*
Detailed study of the problems involved in radiation shielding. The principles of radiation protection are briefly reviewed first. (Lec. 3) *Prerequisite:* NUE 581. In alternate years. Knickle

683 (or CHE 683) Advanced Nuclear Reactor Theory *II, 3*
Advanced treatment of nuclear reactor theory, emphasizing the transport theory and multi-group calculations. Determination of critical size of heterogeneous reactors. Time-dependent transient behavior and basic theory of reactor control are also discussed. Use of digital and analog computers is incorporated. (Lec. 3) *Prerequisite:* NUE 583. Rose

687 (or CHE 687) Nuclear Chemical Engineering *II, 3*
Applications of chemical engineering to the processing of materials for and from nuclear reactors. (Lec. 3) *Prerequisite:* NUE 581 and permission of instructor. In alternate years. Rose

NURSING (NUR)

501, 503 Advanced Clinical Nursing *I or II, 3 each*
Cross-clinical seminar through which the graduate student is helped to broaden and deepen knowledge of theory, concepts and problems that are common to all nursing. (Lec. 3) *Must be taken concurrently with NUR 502, 504.* Staff

502, 504 Advanced Clinical Nursing Practicum *I or II, 3 each*
Intensive study of significant nursing problems in health agencies, selected cooperatively by student and instructor with regard to student's needs and interests. A substantial paper involving independent study in NUR 501, 502, 503, 504 is required. (Lec. 1, Lab. 6) *Must be taken concurrently with NUR 501, 503. Required of all graduate students in nursing.* Staff

505 Research in Nursing *I, 3*
Current research in nursing, emphasizing interpretation and applications. Methodology related to clinical nursing and community health. Students select a problem and develop a project as a learning experience. *Prerequisite:* graduate standing and a basic course in statistics. Staff

510 Teaching in Clinical Nursing *I or II, 3*
A seminar in which the student is assisted in planning, developing, implementing and evaluating classroom and clinical teaching. (Lec. 3) *Prerequisite:* NUR 501,

502. *Must be taken concurrently with NUR 511.* Staff

511 Teaching Practicum *I or II, 3*
Supervised teaching experience in student's major field of interest. (Lec. 1, Lab. 6) *Prerequisite:* NUR 501, 502. *Must be taken concurrently with NUR 510.* Staff

512 Administration in Nursing Service *I or II, 3*
A seminar in which the student is assisted in the development of the philosophy and processes in administration as they relate to nursing service and nursing education. (Lec. 3) *Prerequisite:* NUR 501, 502. *Must be taken concurrently with NUR 513.* Staff

513 Practicum in Administration of Nursing Service *I or II, 3*
Directed experience in nursing service in the student's major field of interest. (Lec. 1, Lab. 6) *Prerequisite:* NUR 501, 502. *Must be taken concurrently with NUR 512.* Staff

OCEAN ENGINEERING (OCE)

457 Fluidics *II, 3*

500 Basic Ocean Engineering *I and II, 3*
Introduction for non-engineering students to the classic engineering disciplines as they relate to marine affairs. Course is descriptive and deals with current engineering practice. (Lec. 3) *Prerequisite:* senior standing. No program credit for graduate engineering students. Sheets

512 Hydrodynamics of Floating and Submerged Bodies I *I, 3*
Hydrodynamic principles associated with floating and submerged bodies: resistance, propulsion, static and dynamic stability. (Lec. 3) *Prerequisite:* MCE 455 or equivalent. Kowalski

513 Hydrodynamics of Floating and Submerged Bodies II *II, 3*
Continuation of OCE 512. Problems of maneuvering, control, and motions in waves. (Lec. 3) *Prerequisite:* OCE 512. Kowalski

521 Materials Technology in Ocean Engineering *I, 3*
Requirements for ocean engineering materials. Material characteristics, fracture toughness, notch sensitivity, energy absorption, speed of loading and fatigue in salt water. Steel, aluminum, titanium, plastics, concrete, and applicable regulations will be discussed. (Lec. 3) *Prerequisite:* permission of instructor. Sheets

524 Marine Structural Design
See Civil Engineering 524.

531 (or MCE 531) Underwater Power Systems *II, 3*
Low output power systems. Overall considerations appropriate to the determination of power require-

ments for underwater systems. (Lec. 3) *Prerequisite:* MCE 342, 448 or permission of instructor. Brown and Rose

532 (or MCE 532) Coastal Zone Power Plants 1, 3
Overall systems consideration for coastal zone power plants. Consideration of factors such as political and legal problems, thermal pollution, and multi-use of plants (aquaculture, etc.). (Lec. 3) *Prerequisite:* MCE 342, 448 or permission of instructor. Brown and Rose

534 Corrosion and Corrosion Control
See Chemical Engineering 534.

535 Advanced Course in Corrosion
See Chemical Engineering 535.

540 (or MCE 540) Environmental Control in Ocean Engineering II, 3
Application of the principles of thermodynamics, heat transfer, and fluid dynamics to the requirements of human survival and engineering operations in deep and shallow water. (Lec. 3) *Prerequisite:* permission of instructor. Schenck

561 Introduction to the Analysis of Oceanographic Data I, 3
Design of oceanic experiments to determine spatial and temporal sampling rates, precision, accuracy, signal-to-noise ratio, etc. Description of typical ocean data collection and analysis systems. Development of relevant techniques. (Lec. 3) *Prerequisite:* IDE 411, MTH 451 or equivalent. LeBlanc

565 Ocean Laboratory I I or II, 3
Measurements, experiments, and the development of apparatus in the ocean from research vessels. Topics covered include statistical theory, planning multi-variable and sequential experiments, checking of data, error-propagation in multi-sensor experiments in the ocean, and at-sea operations. Physical, chemical, and biological measurements would be undertaken as well as application tests on models or full-size apparatus in Narragansett Bay. (Lec. 1, Lab. 6) *Prerequisite:* graduate standing in engineering or oceanography or permission of instructor. Schenck and LeBlanc

566 Ocean Laboratory II I or II, 3
Planning long-term application or environmental experiments in the ocean. Carrying out a synoptic ocean measurement program over a month or more using vessels, buoys, underwater sensors, and locations of opportunity. The student would manage the experiment or measurement scheme so as to make a contribution to engineering or oceanographic knowledge in the area of operation. Preparation of a report on the experimental work. (Lab. 6-8) *Prerequisite:* OCE 565. Schenck and LeBlanc

571 (or ELE 571) Underwater Acoustics I I, 3
Wave equation, energy, pressure and particle velocity.

Acoustic properties of the sea. Elementary sources, refraction, reflection, ray theory, normal modes and scattering, with emphasis on sound propagation in the ocean. (Lec. 3) Moffett and DiNapoli

581 Coastal Engineering Geology
See Geology 581.

587 Submarine Soil Mechanics I, 3
Soil mechanics principles as applied to submarine slope stability, heaving, sinkage and anchorage problems with emphasis on effective stress principle and selection of shear strength of marine sediments. (Lec. 3) *Prerequisite:* CVE 380 or equivalent. Nacci

591, 592 Special Problems I and II, 1-6 each
Advanced work under the supervision of a member of the staff and arranged to suit the individual requirement of the student. (Lec. or Lab. according to nature of problem) *Prerequisite:* permission of department. Staff

599 Masters Thesis Research I and II
Number of credits is determined each semester in consultation with the major professor or program committee.

605, 606 Ocean Engineering Seminar I and II, 1 each
Seminar discussions including presentation of papers based on research or literature survey. (Lec. 1) *Attendance is required of all students in graduate residence. A maximum of 1 credit per year is allowed and no more than 2 credits are allowed for the entire period of residence.* Staff

610 Engineering Ocean Mechanics II, 3
Applied concepts of ocean flow processes; waves due to gravity, wind, and layered media; large and small scale turbulence; prediction of flow instability; wave forces on structures. (Lec. 3) *Prerequisite:* CHE 344, MCE 354 or equivalent. White

651, 652 Advanced Design I and II, 3 each
Advanced course coordinating engineering principles and economics in the design of a complete ocean engineering device. Problems investigated individually with the guidance of one or more instructors. *Prerequisite:* CHE 351, 352 or IDE 404 or equivalent. Staff

653, 654 Ocean Engineering System Studies I and II, 3 each
Systems engineering study of an advanced ocean engineering problem. Students will operate as a complete engineering team with specific subsystems designs done with individual faculty members. (Lec. 3) Sheets

661 Analysis of Oceanographic Data Systems I, 3
Design of systems for deep ocean and estuarine data collection and processing. Space-time sampling, multivariate analysis and convergence of moments as applied to ocean data estimation and system design.

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Current topics in ocean data systems. (Lec. 3) *Prerequisite: ELE 506 or equivalent.* LeBlanc

672 (or ELE 672) Underwater Acoustics II II, 3
Transducers, radiators and receivers, directivity (array structures) equivalent circuits, efficiency; piezoelectricity, magnetostriction, sonar principles, measurements and calibration. (Lec. 3) Moffett and DiNapoli

673 Advanced Course in Underwater Acoustic Propagation I, 3
Analysis of propagation from a concentrated acoustic source in the ocean by methods such as advanced normal mode theory, numerical integration and fast Fourier transforms. Applications to ocean features such as surface ducts, shadow zones, deep sound channel, etc. (Lec. 3) *Prerequisite: OCE 571 or equivalent.* DiNapoli

674 Nonlinear Acoustics II, 3
Topics in the nonlinear acoustics of fluids. Propagation and interactions of finite-amplitude sound waves. Parametric sonar. Sound generation by turbulence. Cavitation noise. Shock waves. Underwater explosions. Radiation pressure and acoustic streaming. (Lec. 3) *Prerequisite: OCE 571 or permission of instructor.* Moffett

675 Processing of Underwater Acoustic Data II, 3
Description of the underwater acoustic environment. Methods of measuring underwater acoustic signals. Data analysis of passive and active signals. Applications of underwater acoustics to oceanographic survey. (Lec. 3) *Prerequisite: ELE 506 or equivalent.* LeBlanc

691, 692 Special Problems I and II, 1-6 each
Advanced work under supervision of a member of the staff and arranged to suit the individual requirements of the student. (Lec. or Lab. according to nature of problem) *Prerequisite: permission of department.* Staff

699 Doctoral Dissertation Research I and II
Number of credits is determined each semester in consultation with the major professor or program committee.

OCEANOGRAPHY (OCG)

401 General Oceanography I, 3

501 Physical Oceanography I, 3
Basic course covering all aspects of physical oceanography. Physical properties of seawater, heat budget, distribution of variables, dynamics, water masses and general circulation. Waves, tides, history and interrelationships with other marine sciences. (Lec. 3) *Prerequisite: PHY 213, MTH 141.* Knauss

509 Ecological Aspects of Marine Pollution II, 2
Biological, chemical, and physical aspects of selected

agricultural, industrial, and domestic effluents in the marine and estuarine environment. Case histories emphasizing toxicological effects. The concept of bioassay as an analytical tool is developed through demonstrations and discussion. (Lec. 2) *Prerequisite: OCG 401 or permission of instructor.* Eisler

510 Descriptive Physical Oceanography II, 3
Observed distributions of temperature, salinity, currents; methods of deducing deep flow; physical properties of seawater; flow in estuaries; practical work in the analysis of oceanographic data; study of recent literature. (Lec. 3) *Prerequisite: OCG 501. In alternate years, next offered 1973-74.* Sturges

521 Chemical Oceanography II, 3
Processes regulating the composition of seawater, and the distribution of chemical species. The interaction of marine chemistry with the ocean floor, atmosphere and marine organisms. (Lec. 2, Lab. 2) *Prerequisite: CHM 103, 104 and 112, PHY 213.* Pilson

524 Chemistry of the Marine Atmosphere II, 3
Chemical fractionation and the production of aerosols at the air-sea interface, interaction between marine atmospheric trace gases, aerosols, and precipitation; cycles, budgets, and reactions of atmospheric nitrogen and sulfur compounds, carbon monoxide, ozone, the halogens, and organic matter; effect of man on the marine atmosphere. (Lec. 3) *Prerequisite: OCE 521 and CHM 332 or permission of instructor. In alternate years, next offered 1974-75.* Duce

540 Geological Oceanography II, 3
Survey of marine geology and its relationship to other marine sciences. Beaches and coastal evolution; geomorphology, sedimentary processes, structure, volcanism and tectonics of continental margins, ocean basin floor, and mid-oceanic ridges; origin of ocean basins. Laboratory emphasizes instrumentation, procedures and the interpretation of marine geological data. (Lec. 2, Lab. 2) *Prerequisite: GEL 103 or ESC 105 or permission of instructor.* McMaster

545 Geomagnetism and Paleomagnetism I, 3
The description of the past and present magnetic fields of the Earth. The principles, methods, and results of the application of paleomagnetism to diverse geological, geophysical, and paleontological problems. Lectures and seminars. *Prerequisite: PHY 213 and/or 214 and MTH 142 and/or 243 and/or 244 and some geology, GEL 103 and/or 104, or permission of instructor.* Staff

547 Seminar in Biomagnetism I, 2
Effect of weak and strong magnetic fields on marine and terrestrial organisms in the present and in the past. Introductory lectures on artificial and natural magnetic fields, followed by seminars by students and guests. (Lec. 2) *Prerequisite: permission of instructor.* Watkins

561 Biological Oceanography I, 3
Nature of life in the sea; adaptations, patterns of dis-

tribution and production of plankton, nekton and benthos, their interrelationships and interaction with the environment. (Lec. 2, Lab. 2) *Prerequisite: ZOO 111.* Pratt

567 Marine Bacteriology I, 3
Present concepts of the distribution, nature, and functions of bacteria and related microorganisms in the marine environment. Methodology will include sampling, culture, taxonomy and study in regard to their physical and physiological ecology. (Lab. 6) *Prerequisite: CHM 104 and MIC 201, or permission of instructor. In alternate years, next offered 1974-75.* Sieburth

568 Fishery Biology II, 3
Biology of fish populations and methods of fishery research, including influence of environmental factors on morphology, physiology, abundance and distribution of fishes, estimation of stocks, growth, aging, mortality, measurement of fish production and theory of fishery regulation. (Lec. 3) *Prerequisite: permission of instructor.* Saila

571 Benthic Environment I, 3
Lectures, readings, seminar presentations, discussion and project work on the physical-chemical properties and the total ecology of the benthic marine environment. Includes tidal marshes, rocky intertidal areas, estuarine shoals, coral reefs and the deep-sea benthos. (Lec. 2, Lab. 2) *Prerequisite: permission of instructor.* Nixon

574 Biology of Marine Mammals II, 2
Migration, reproduction, social organization, classification, anatomy, populations, physiology and communications of cetaceans and pinnipeds. (Lec. 1, Lab. 3) *Prerequisite: permission of instructor. In alternate years, next offered 1974-75.* Winn

599 Masters Thesis Research I and II
Number of credits is determined each semester in consultation with the major professor or program committee.

605 Dynamical Oceanography I, 3
Simple steady state theories applied to ocean motion. Review of well-known force balances in oceanography, wind driven circulation, thermohaline circulation, the thermocline, oceanic boundary layers, near shore circulation, diffusion. (Lec. 3) *Prerequisite: OCG 501.* Kenyon

607 (612) Geophysical Models I, 4
Selected laboratory experiments modeling the motions of oceans and atmospheres. Comparison of effects of rotation and stratification. Thermal and thermohaline convection, inertial waves and boundary layer phenomena. Emphasis on experimental research techniques and preparation of technical reports. (Lec. 3, Lab. 3) *In alternate years, next offered fall 1974.* Lambert

609 Dynamics of Mixing I, 3
Theories of the thermocline and the problem of vertical mixing. Relation of mean vertical mixing coefficients to detailed mechanisms of mixing. Internal waves, shear instabilities, lateral spreading and entrainment, thermohaline convection, small scale turbulence. (Lec. 3) *Prerequisite: permission of instructor. In alternate years, next offered fall 1973.* Lambert

611 Geophysical Hydrodynamics II, 3
Fluid dynamics of rotating bodies with application to earthy phenomena. Figure of the earth. Conservation laws and rotational constraints. Geostrophic and quasi-geostrophic motion. Hydrodynamic instability applied to generation of surface gravity waves. Laminar and turbulent Ekman boundary layers. Wind-driven ocean circulation. Waves and circulation caused by density variations. (Lec. 3) *Prerequisite: permission of instructor.* Stern

613 Waves I, 3
Generation, propagation and decay of surface waves, internal waves, and Rossby waves in the ocean. (Lec. 3) *Prerequisite: MCE 550 or permission of instructor.* Kenyon

614 Tides II, 1
Generation, propagation, and dissipation of ocean tides. Relation between theory and observation. (Lec. 1) *Prerequisite: OCG 501.* Kenyon

621 (or REN 621) The Estuary and Coastal Zone I, 3
Multi-disciplinary course on the characteristics of estuaries and adjacent coastal waters and the ecological, economic, engineering and other considerations applicable to the development, management, and conservation of such waters. (Lec. 2, Rec./Proj. 1) *Prerequisite: advanced (second year) graduate standing and approval of course chairman.* Marshall and Lampe

623 Physical Chemistry of Seawater I, 3
The characterization of dissociation, solubility and redox equilibria in seawater. Partial molar volumes, conductivity and diffusion of ions in seawater. Kinetic studies in seawater and the effects of temperature, salinity and pressure on physicochemical properties in seawater. (Lec. 3) *Prerequisite: OCG 521 and CHM 332 or permission of instructor.* Kester

625 Organic Geochemistry I, 3
Chemistry of organic matter in seawater and recent marine sediments. Topics include source, characterization, significance and fate of dissolved, particulate and sedimentary organic compounds. (Lec. 3) *Prerequisite: CHM 222 or permission of instructor.* Quinn

630 Geochemistry II, 3
Introduction to the study of the distribution of the elements in the natural environment. Emphasis is placed upon an understanding of the chemical principles

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ciples and chemical processes which govern this distribution. (Lec. 3) *Prerequisite: CHM 104 or 112 and GEL 103 or permission of instructor.* Schilling

F631 Seminar in Marine Chemistry I and II, 1
Discussion of problems of current interest in marine chemistry. (Lec. 1) *Prerequisite: OCG 521 or permission of instructor.* Staff

F643 Seminar in Deep-sea Geology I, 3
Class discussion of selected topics in deep-sea geology based on extensive reading in the scientific literature. A research paper by each student and lectures will supplement the discussions. (Lec. 3) *Prerequisite: permission of instructor.* Krause

S644 Thermodynamics of the Earth's Interior II, 3
Review and application of thermodynamics to geological problems. Crystal-melt equilibria, phase transitions, hydration reactions; coprecipitation laws and fractionation processes; effect of the geothermal and pressure gradients, convection. (Lec. 3) *Prerequisite: GEL 103 and a course in thermodynamics such as CHM 433, or PHY 420, or CHE 313 and 314, or MCE 341 or permission of instructor.* Schilling

F645 Geology of Continental Margins I, 3
Geomorphology, sedimentology and structure of continental shelves, borderlands, slopes and rises with consideration of origin and developmental processes of continental margins. (Lec. 3) *Prerequisite: OCG 540, GEL 470 and 550. Offered in fall of odd calendar years.* McMaster

S646 Deep Sea Sediments and Processes II, 3
Deep-sea sediments and their relation to oceanic processes such as solution, productivity and dilution. Sedimentary distributions in time and space as related to tectonic models. Paleoclimatology, and past water mass distributions and conditions. Term paper. (Lec. 3) *Prerequisite: permission of instructor. In alternate years, next offered spring 1974.* Kennett

F647 Recent Sedimentary Environments I, 3
Concentrated study of the sedimentary environments of beach, estuary, continental shelf, slope, and rise, with primary emphasis on the relationships between the sediment properties of each environment and its environmental conditions. (Lec. 3) *Prerequisite: OCG 501, 540, GEL 550. Offered in the fall of even calendar years.* McMaster

F649 (648) Marine Paleocology I, 3
Concepts of paleocology. Review of Pleistocene and Tertiary paleo-oceanography, paleoclimatology and paleocology. Criteria and methods used in marine paleocology especially those related to foraminifera radiolaria. Biogeography and paleocology of Cenozoic planktonic faunas. (Lec. 2, Lab. 1) *In alternate years, next offered fall 1974.* Kennett

new 73-74 F651 Cenozoic Marine Stratigraphy I, 2
Extensive reading and class discussion of concepts

and methods of biostratigraphy, chronostratigraphy and lithostratigraphy as applied to the Cenozoic. Stratigraphic nomenclature. Problems and advances in correlation and dating of marine sediments from distinct oceanographic regimes including type European sections. (Lec. 2) *In alternate years, next offered fall 1973.* Kennett

F661 (or BOT 661) Phytoplankton Taxonomy I, 3
Classical and modern systems and techniques for the identification, nomenclature, and classification of planktonic algae, with emphasis on marine forms. Phylogeny will be briefly considered. (Lec. 1, Lab. 4) *Prerequisite: permission of instructor. In alternate years, next offered fall 1974.* Hargraves

S662 Ecological Concepts in Marine Research II, 3
Advanced course in ecology with emphasis on marine environment. Ecological theory pertaining to population dynamics, energy in ecological systems and the application of quantitative biology in oceanography. Application of experimental methods in ecological research. (Lec. 3) Jeffries

F663 (or BOT 663) Phytoplankton Physiology I, 3
Metabolic processes and methods of their investigation in phytoplankton with primary emphasis on functions pertinent to their ecology. Includes adaptation, uptake of nutrients, excretion, rhythms, pigments, and photosynthesis. (Lec. 3) *Prerequisite: permission of instructor.* Swift

S664 (or BOT 664) Phytoplankton Ecology II, 4
Biology, ecology, methods of investigation and introductory systematics of the pelagic marine microscopic plants; stress on their adaptations, physiological ecology, distribution, succession, production, and regional and seasonal dynamics. (Lec. 3, Lab. 3) *Prerequisite: permission of instructor.* Smayda

F666 Zooplankton I, 3
Biology of marine zooplankton, dealing with morphology, adaptation, distribution, physiology, production and interrelationships with other members of the marine biota. (Lec. 1, Lab. 4) *Prerequisite: permission of instructor.* Napora

S667, 668, 669 (or BOT 667, 668, 669) Advanced Phytoplankton Seminars II, 2 each
Specialized and advanced areas of phytoplankton biology and research, including systematics, physiology and ecology. (Sem. 3) *Prerequisite: permission of instructor.* Hargraves, Smayda and Swift

S672 Marine Invertebrates and Environment II, 3
Physiological responses of marine invertebrates to seasonal and geographical changes in the environment. Survival, metabolism, reproduction and larval development of the populations. Mechanisms in adaptation during all stages in the life cycle will be examined in relation to changes of certain environmental factors. Physiological variation of populations as it relates to the speciation process in the sea. Lec-

tures, reading and discussion from the literature. A research project is expected of each student. (Lec. 3) *Prerequisite: OCG 561 and permission of instructor.* Sastry

679 (or ZOO 679) Animal Communication *I, 2*
Visual, chemical and auditory communication in animals, including receptor systems, feedback and redundancy. Functional aspects and organization of communication. Discussion of readings. Research problem can be taken under OCG 691 or ZOO 693. (Lec. 2) *Prerequisite: ZOO 467 or equivalent and permission of instructor. In alternate years, next offered 1974-75.* Winn

681 (or ZOO 681) Biological Clocks and Orientation *I, 2*
Circadian, lunar-tidal, annual, and other activity rhythms. Orientation particularly related to migratory and daily movements. Covers sun, moon and star compass, odor trails, magnetic factors, echolocation, and other factors. Research problem can be taken under OCG 691 or ZOO 693. (Lec. 2) *Prerequisite: ZOO 467 or equivalent and permission of instructor. In alternate years, next offered 1975-76.* Winn

691, 692 Individual Study *I and II, 1-6 each*
Individual study of assigned topics or special problems, involving literature search and/or original investigation under one or more members of the staff. (Lec., Lab. TBA) Staff

693, 694 Special Studies *I and II, 1-4 each*
Studies of specialized topics in the marine sciences. (Lec., Lab. TBA) Staff

695 Seminar in Oceanography *I and II, 1*
Students to give seminar reports on problems and current research in various areas of oceanography. Attendance is required of all students in graduate residence but no more than 4 hours are allowed for a program of study. (Lec. 1) Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

Note: graduate students in oceanography choose from supporting courses in other departments.

ORGANIZATIONAL MANAGEMENT AND INDUSTRIAL RELATIONS (OMR)

407 Administrative Practices *I, 3*
422 Labor Legislation *II, 3*
423 Industrial Relations *II, 3*
431 Advanced Management Seminar *I, 3*

491, 492 Special Problems *I and II, 3 each*

504 Business Policy *II, 3*
Determination of objectives and planning programs of action, creating an organization and launching a program; controlling execution of plans; reappraising objectives. These goals are attained through emphasizing administrative situations as described in cases. (Lec. 3) *Prerequisite: permission of department.* Staff

530 (930) Management Theory and Practice *I and II, 2*
Management applied to business, objectives, policies, organization staffing and control; production personnel, behavioral science applications; the role of quantitative methods. (Lec. 2) Staff

626 Organizational Behavior *I and II, 3*
Incorporates the insights gleaned from the disciplines of psychology, sociology, anthropology and the social sciences of politics, economics and history in the study of the behavior of organizations and of their principal actors. (Lec. 3) *Prerequisite: OMR 530 or equivalent.* Staff

627 Advanced Organization Theory and Behavior *I and II, 3*
Utilizing previous knowledge of classical and traditional management thought, students are provided with concepts, analytical approaches, and skills for understanding how behavioral sciences influence complex organizational systems. (Lec. 3) *Prerequisite: OMR 626.* Staff

631 Human Resources Management *I and II, 3*
The role of human resources management and its functional relationship within an organization with emphasis on behavioral concepts and their application. Text, cases and research. (Lec. 3) *Prerequisite: OMR 530.* Raffaele

632 Managerial Economics *I and II, 3*
Mathematics, statistics, and econometrics as tools in dealing with typical problems of managerial economics; application of economic concepts to decision making of the firm. (Lec. 3) *Prerequisite: ECN 990, MGS 580, 581, or equivalent.* Staff

638, 639 Seminar in Industrial Management *I and II, 3 each*
Class discussion of typical cases, original research work in the field of industry with discussion of data collected and analyzed by individual students. (Lec. 3) *Prerequisite: permission of department.* Staff

PHARMACOGNOSY (PCG)

445, 446 General Pharmacognosy *I and II, 4 each*
447 General Pharmacognosy Laboratory *I and II, 1*
459 Public Health *I, 3*

497, 498 Special Problems

I and II, 1-3 each

research report on one or more assigned topics. (Lab. TBA) Staff

521, 522 Seminar

I and II, 1 each

Seminar discussions including presentation of papers on selected topics in pharmacognosy. (Lec. 1) Students attend seminar each semester while in graduate residence, but a maximum of 1 credit per year is allowed. Not more than 3 credits allowed for entire period of residence. Staff

533 Medicinal Plants

I and II, 2

Problems in drug plant chemotaxonomy with field work in the drug plant gardens. Emphasis is placed on certain alkaloid, glycoside and oil-yielding plants. Weedicides and insecticides as related to measures for control. (Lec. 1, Lab. 3) Prerequisite: PCG 446 or permission of department. Staff

536 Antibiotics

II, 3

Advanced course dealing with the concept of antibiosis, biosynthesis pathways of antibiotic production, testing, chemistry, mechanism of action, medicinal and pharmaceutical uses of antibiotics. Phenomena of sensitivity and resistance with emphasis on those entities of importance in pharmaceutical research and production. (Lec. 3) Prerequisite: permission of department. In alternate years. Worthen

548 Physical Methods of Identification

See Medicinal Chemistry 548.

551, 552 Chemistry of Natural Products

I and II, 3 each

Introduction to the chemistry of certain groups of natural products especially in relation to their chemotaxonomic position in plant classification. Topics limited to secondary metabolites: e.g. terpenoids, phenolic compounds, aromatic compounds, phytosterols, and alkaloids. (Lec. 3) Prerequisite: CHM 228 and 230. In alternate years, next offered 1973-74. Shimizu and Lyon

599 Masters Thesis Research

I and II

Number of credits is determined each semester in consultation with the major professor or program committee.

633, 634 Biosynthesis

I and II, 3 each

Biogenesis of medicinally active principles of biological origin. Emphasis given to organic acids, polysaccharides, glycosides, steroids and certain nitrogenous compounds. (Lec. 3) In alternate years, next offered 1973-74. Staff

635, 636 Pharmacognosy Techniques

I and II, 3-4 each

Physical and chemical factors influencing growth and development of active principles of drug plants. Certain biological analyses of results are performed. (Lec. 1, Lab. 6-9) Staff

697, 698 Research in Pharmacognosy

I and II, 1-3 each

Literature survey, laboratory work and a detailed

699 Doctoral Dissertation Research

I and II

Number of credits is determined each semester in consultation with the major professor or program committee.

PHARMACOLOGY AND TOXICOLOGY (PCL)
441, 442 General Pharmacology

I and II, 4 each

443, 444 General Pharmacology Laboratory

I and II, 1 each

453 Clinical Pharmacology and Toxicology

I, 3

497, 498 Special Problems

I and II, 1-3 each

521, 522 Seminar

I and II, 1 each

Seminar discussions and presentation of papers on selected topics in pharmacology. (Lec. 1) Students attend seminar each semester while in graduate residence, but a maximum of 1 credit per year is allowed. No more than 3 credits are allowed for the entire period of residence. Staff

542 Evaluation of Drug Effects

II, 5

Theory, methods and techniques involved in the determination of qualitative and quantitative activity and relative toxicity of drugs. (Lec. 2, Lab. 9) Prerequisite: PCL 441 and 442, MGS 501, or equivalent and permission of department. In alternate years. DeFanti and DeFeo

544 Forensic Toxicology

II, 3

Theoretical and practical aspects of poisoning including the isolation and identification of toxic materials from pharmaceuticals, body fluids and tissues. Isolation and identification of physiological fluids from stains, hairs, and tissue with application to forensic medicine. (Lec. 2, Lab. 3) Prerequisite: PCL 441, 442 and permission of department. In alternate years, next offered 1973-74. DeFanti

546 Advanced Toxicology

II, 4

Toxic effects of selected drugs and other xenobiotics on physiological and biochemical processes. (Lec. 3, Lab. 4) Prerequisite: PCL 441, 442 or equivalent, and permission of department. In alternate years, next offered 1973-74. Carlson

550 Operant Analysis of Behavior

See Psychology 550.

562 Psychopharmacology

II, 3

Effects of drugs on animal and human behavior and on related biochemical processes. (Lec. 3) Prerequisite: PCL 441 or equivalent and/or permission of department. In alternate years. Lal

564 Psychopharmacology Laboratory II, 1-3
 Laboratory exercises to demonstrate effects of drugs on animal and human behavior. To earn more than one credit, the student will engage in original work of limited scope. (Lab. 3-9) *Prerequisite: PCL 441 or equivalent and/or permission of department.* Lal

572 Neural Bases of Drug Action II, 3
 Review of neuroanatomy, neurochemistry, and neurophysiology as they are related to drug action. (Lec. 3) *Prerequisite: PCL 441 or equivalent and/or permission of department. In alternate years, next offered 1973-74.* Lal

599 Masters Thesis Research I and II
 Number of credits is determined each semester in consultation with the major professor or program committee.

641 Biochemical Pharmacology I, 4
 Theory and application of pharmacological studies at the cellular and subcellular levels and their significance to drug action in the intact organism. (Lec. 3, Lab. 3) *Prerequisite: PCL 441 and 442 and permission of department. In alternate years, next offered 1973-74.* Fuller

643 Advanced Pharmacology and Techniques I, 4
 Mechanism of action of drugs on living tissues, organs and organisms with particular emphasis on cellular physiology as a basis of explanation of tissue response. Advanced laboratory techniques as employed for pharmacological testing. (Lec. 2, Lab. TBA) *Prerequisite: PCL 442, and permission of department. In alternate years.* DeFeo

697, 698 Research in Pharmacology I and II, 1-5 each
 Literature survey, laboratory work and a detailed research report on one or more assigned topics. (Lab. TBA) Staff

699 Doctoral Dissertation Research I and II
 Number of credits is determined each semester in consultation with the major professor or program committee.

PHARMACY (PHC)

425 History of Pharmacy I and II, 3

451 Clinical Pharmacy I, 3

497, 498 Special Problems I and II, 1-3 each

501 Drug Information Pertaining to Institutional Pharmacy Practice I, 3
 Discussion and evaluation of drug information sources, and how to use these sources. Includes the methodology of establishing and maintaining drug information services. (Lec. 2, Pract. 3) Jeffrey and Staff

521, 522 Seminar I and II, 1 each
 Seminar discussions including presentation of papers on selected topics in pharmacy. (Lec. 1) *Students attend seminar each semester while in graduate residence, but a maximum of 1 credit per year is allowed. Not more than 3 credits are allowed for the entire period of residence.* Staff

552 Advanced Clinical Pharmacy II, 3
 In-depth study of clinical pharmaceutical methods and the applications of these methods in the clinical environment on rounds and in conferences. (Lec. 1, Lab. 6) *Prerequisite: PHC 451.* Jeffrey, Galina and Staff

599 Masters Thesis Research I and II
 Number of credits is determined each semester in consultation with the major professor or program committee.

611, 612 Residency in Hospital Pharmacy I and II, 6 each
 The residency consists of 2,000 hours of training and practice, under supervision, in the hospital pharmacy as prescribed and accredited by the American Society of Hospital Pharmacists. Jeffrey, Galina and Fish

621, 622 Manufacturing Pharmacy I and II, 2-5 each
 Theory of and practice in the manufacture of pharmaceuticals and the principles of operation of the equipment used for their production. (Lec. 2, Lab. 0-9) Gerraughty, Gloor, and Paruta

625, 626 Hospital Pharmacy Administration I and II, 2 each
 Hospital organizations, including intra- and inter-departmental relationships, the medical and service staff problems, the administrator, personnel management, pharmaceutical service with relation to patient care, medical and pharmaceutical research. (Lec. 3) Gerraughty and Paruta

631 Advanced Physical Pharmacy I, 3-5
 Application of physical-chemical principles to problems in pharmaceutical research, with emphasis on methods by which properties of new medicinal and pharmaceutical agents are determined. (Lec. 3, Lab. 3-6) *Prerequisite: CHM 332 or permission of department.* Gerraughty, Gloor and Paruta

632 Advanced Physical Pharmacy II, 2-4
 Application of physical-chemical principles to problems in pharmaceutical research, with emphasis on methods by which properties of new medicinal and pharmaceutical agents are determined. (Lec. 2, Lab. 0-6) *Prerequisite: PHC 631.* Staff

641 Pharmaceutical Formulations I, 2-4
 Methods of solving problems in pharmaceutical formulations to obtain therapeutically active, stable, and esthetically acceptable dose forms. (Lec. 2, Lab. 3-6) *Prerequisite: PHC 632.* Gerraughty and Gloor

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642 Pharmaceutical Formulations II, 2-5
Methods of solving problems in pharmaceutical formulations to obtain therapeutically active, stable, and esthetically acceptable dose forms. (Lec. 2, Lab. 3-9) *Prerequisite: PHC 641.* Staff

662 Biopharmaceutics I, 3
Pharmacokinetic principles as applied to absorption, metabolism, and excretion of drugs from finished dosage forms. Includes oral, parenteral, topical and sustained release forms. (Lec. 3) *Prerequisite: PHC 384. In alternate years, next offered 1973-74.* Ballard

697, 698 Research in Pharmacy I and II, 1-3 each
Literature survey, laboratory work and a detailed research report on one or more assigned topics in pharmacy. (Lab. TBA) Staff

699 Doctoral Dissertation Research I and II
Number of credits is determined each semester in consultation with the major professor or program committee.

PHARMACY ADMINISTRATION (PAD)

405 Pharmacy Personnel Administration I, 2

406 Pharmacy Retailing II, 4

451 Pharmacy Administration Principles II, 3

453 Drug Marketing Principles II, 2

497, 498 Special Problems I and II, 1-3 each

570 Case Studies in Pharmacy Law II, 3
Case studies and a detailed analysis of the FDC, Harrison narcotic, hazardous substances, poisons and public health insurance laws. (Lec. 3) *Prerequisite: PAD 351.* Campbell and Jacoff

580 Prepaid Drug Plans I, 3
Institutional relationships involved in the prescribing, dispensing and prepayment of drugs. Problems of interference with pharmaceutical or medical practice arising from different types of prepayment plans. Actual experience, laws and court decisions, abuse and controls. (Lec. 3) *Prerequisite: PAD 451 and 453.* Campbell and Jacoff

599 Masters Thesis Research I and II
Number of credits is determined each semester in consultation with the major professor or program committee. Staff

621, 622 Seminar I and II, 1 each
Seminar discussions and presentation of papers on selected topics in pharmacy administration. (Lec. 1) *Students attend seminar each semester while in graduate residence, but a maximum of 1 credit per year is allowed. Not more than 3 credits are allowed for the entire period of residence.* Staff

651, 652 Health Care Systems I and II I and II, 3 each
Arrangements for utilizing pharmaceutical resources in public and private systems of health care in the U.S. and other countries. Variations in quality and distribution of care among socio-economic groups. (Lec. 3) *Prerequisite: PAD 580 and BST 501 or equivalent.* Jacoff

697, 698 Research in Pharmacy Administration I and II, 1-3 each
Literature survey, laboratory work and a detailed research report on one or more assigned topics in pharmacy administration. (Lab. TBA) Staff

PHILOSOPHY (PHL)

401, 402 Special Problems I or II, 3 each

405 Aesthetics I or II, 3

440 Philosophy of Language I or II, 3

441 Metaphysics I or II, 3

442 Epistemology I or II, 3

502, 503, 504, 505 Tutorial in Philosophy I and II, 3 each
Discussion by the staff and advanced students of research problems in philosophy. Presentation and criticism of original papers. (Lec. 3) Staff

512 Seminar in Ethics and Value Theory I or II, 3
Intensive studies of various issues, theories and aspects in the field of values and valuation. The texts of leading moralists will be carefully analyzed. (Lec. 3) *In alternate years.* Staff

530 Philosophy of Plato I or II, 3
Selected dialogues from the later period. Particular attention will be given to the areas of metaphysics, epistemology, cosmology, and ethics. (Lec. 3) *In alternate years.* Staff

531 Philosophy of Aristotle I or II, 3
Selected texts with emphasis on the major concepts of Aristotle's metaphysics, theory of knowledge, and ethics. (Lec. 3) *In alternate years.* Staff

540 Philosophy of Augustine I or II, 3
Examination of the philosophical background of Augustine's thought and of his doctrines of knowledge and reality with reference to his influence on the subsequent philosophical development in medieval and modern thought. (Lec. 3) *In alternate years.* Staff

541 Philosophy of Aquinas I or II, 3
Critical examination of the major contribution of Aquinas to metaphysics, epistemology, and philosophical psychology. (Lec. 3) *In alternate years.* Staff

- 551 Philosophical Logic** *I or II, 3*
 Intensive consideration of such issues as the nature, structure and function of propositions, predication and the analysis of the "is" relation. The relation between propositions and facts. The nature of logic and the criterion of the logical and the relation of logic to language, psychology and ontology. (Lec. 3) *In alternate years.* Staff
- 552 Philosophy of Science** *I or II, 3*
 An inquiry into the nature and history of scientific thought, with emphasis on the analysis of fundamental concepts of the physical and biological sciences in the order of human knowledge and on their importance for human existence. (Lec. 3) *Prerequisite: PHL 101 and a year of either physical or biological science or permission of instructor.* Staff
- 560 British Empiricists** *I or II, 3*
 Intensive analysis of the work of one or more of the British empiricists: Locke, Berkeley, or Hume. (Lec. 3) *In alternate years.* Staff
- 561 Continental Rationalists** *I or II, 3*
 Intensive analysis of the work of one or more of the continental rationalists: Descartes, Spinoza or Leibnitz. (Lec. 3) *In alternate years.* Staff
- 570 Philosophy of Immanuel Kant** *I or II, 3*
 Intensive analysis of major texts. Special attention will be given to *The Critique of Pure Reason*. (Lec. 3) *In alternate years.* Staff
- 580 Nineteenth-Century Philosophy** *I or II, 3*
 Intensive analysis of the work of a major philosopher or philosophical movement. Attention will be given to such major figures as Hegel, Kierkegaard, C. S. Peirce, or James. The specific subject changes from year to year. (Lec. 3) *In alternate years.* Staff
- 581 Twentieth-Century Anglo-American Philosophy** *I or II, 3*
 Intensive analysis of the work of one contemporary British or American philosopher or philosophical movement. The specific subject changes from year to year. (Lec. 3.) *In alternate years.* Staff
- 590 Contemporary European Philosophy** *I or II, 3*
 Intensive analysis of the works of selected representatives of such schools as neo-Kantianism, phenomenology, neo-positivism, neo-Hegelianism, historicism, and vitalism. (Lec. 3) *In alternate years.* Staff
- 599 Masters Thesis Research** *I and II*
 Number of credits is determined each semester in consultation with the major professor or program committee.
- 410 Corrective and Adaptive Physical Education** *I, 3*
Physical Education for Women (PEW) 410.
- 495 Directed Study** *I and II, 3*
Physical Education for Women (PEW) 495.
- 510 Current Problems in Physical Education, Health and Recreation** *I or II, 3*
 Current problems in physical education, health, and recreation designed to acquaint the students with conditions that give rise to problems and various techniques used in finding solutions to them. (Lec. 3) *Prerequisite: permission of department.* Staff
- 520 Curriculum Construction in Physical Education** *I or II, 3*
 Analysis of criteria and procedures for curriculum construction in physical education. Standards for the evaluation and revision of elementary and secondary school physical education courses. (Lec. 3) *Prerequisite: permission of department.* Polidoro
- 530 Research Methods and Design in Health and Physical Education** *I or II, 3*
 Introduction to methodology in experimental, laboratory, curriculum, action, and historical research. (Lec. 3) *Prerequisite: competence in basic statistics and permission of department.* Sonstroem
- 540 Principles of Recreation Leadership** *I or II, 3*
 Modern concepts of responsibilities involved in program planning in schools and community agencies. Leadership of committees and board relations as well as practical program promotional techniques. (Lec. 3) *Prerequisite: permission of department.* Leathers
- 543 Outdoor Recreation and Education** *I or II, 3*
 Investigation of the present scope and significance of the present-day outdoor recreation and education movements and an examination of current ideas and practices. (Lec. 3) *Prerequisite: permission of department.* Leathers
- 550 Administration of Physical Education** *I or II, 3*
 Problems and procedures for administering a physical education program studied from the viewpoint of the physical education administrator, the school administrator and the faculty. Emphasis is placed upon the study of administrative cases. (Lec. 3) *Prerequisite: PEM 380.* Nedwidek
- 560 Seminar in Health, Physical Education and Recreation** *I or II, 3*
 Selected topics within the three areas, depending on availability of specialized instruction including visiting professorships. (Lec. 3) *Prerequisite: permission of department.* Staff
- 570 Major Health Problems and Curriculum Planning in Health Education** *I or II, 3*
 Major health problems related to personal and community health with emphasis on health education,

PHYSICAL EDUCATION (PED)

410 Adaptive and Corrective Physical Education *I, 3*
Physical Education for Men (PEM) 410.

curriculum planning and evaluation. (Lec. 3) *Prerequisite: permission of department.* DelSanto

575 Perceptual-motor Education *I or II, 3*
 The role of motor activity in enhancing perceptual development and how the physical educator can become involved in cooperation with other school personnel in the implementation and continuing development of perceptual-motor programs. For teachers in elementary schools and in special education who wish to incorporate motor activities into their programs. (Lec. 3) *Prerequisite: PSY 113, 232 and permission of instructor.* McCormick

580 Physical Education for the Mentally Retarded *I, 3*
 Introduction to the contributions of physical education to the growth and development of mentally retarded. Basic movement, rhythms, games, sports, stunts, tumbling, gymnastics, apparatus, etc. for both educable and trainable mentally retarded. (Lec. 3) *Prerequisite: PSY 442 and/or permission of department.* McCormick

581 Psychological Aspects of Physical Activity *II, 3*
 Scientific principles and research from psychology are studied and related to physical activity. Educational program situations amenable to research and the application of psychological principles are isolated. Major emphasis is utilized to recommend improvements in physical education methodology. (Lec. 3) *Prerequisite: PSY 113, 232 and permission of instructor.* Sonstroem

585 Physical Education for the Atypical Child *I, 3*
 Limitations, needs, learning characteristics of the physically and mentally handicapped child which apply to verbal response, body control, kinethesis and neuromuscular acceptance. Research reviewed and synthesized for a practical problem. (Lec. 3) *Prerequisite: ZOO 121, 142, and kinesiology recommended.* Slader

591 Special Problems *I or II, 3*
 Requirements are satisfied by writing a paper reporting the in-depth investigation of a pertinent problem in the field, including a review of relevant literature, analysis and solution of the problem based on scientific methodology, and recommendations for improved practices. *Limited to and required of all master's degree candidates in physical education who elect the non-thesis option.* Staff

599 Masters Thesis Research *I and II*
 Number of credits is determined each semester in consultation with the major professor or program committee.

PHYSICS (PHY)

401, 402 Seminar in Physics *I and II, 1 each*

406 Introduction to Atmospheric Physics *I, 3*

420 Introduction to Thermodynamics and Statistical Mechanics *I, 3*

421 Introduction to Theoretical Physics *I, 3*

425 Acoustics *I, 3*

431 Introduction to Theoretical Physics *II, 3*

451 Atomic and Nuclear Physics *I, 3*

452 Nuclear Physics *II, 3*

455 Introduction to Solid State Physics *II, 3*

483, 484 Laboratory and Research Problems in Physics *I and II, 3 each*

491, 492 Special Problems *I and II, 1-6 each*

510, 511 Mathematical Methods of Physics *I and II, 3 each*

Definition of a vector, vector algebra and calculus, scalar and vector fields, linear vector operators, coordinate transformations, vector operations in curvilinear coordinates, dyadics, tensors, simple applications of the theory of finite groups. Partial differential equations of physics and their solutions; diffusion equation, wave equation, Schrodinger equation, Klein-Gordon equation, elements of the theory of probability. (Lec. 3) *Prerequisite: permission of department.* Hart

520 Classical Dynamical Theory I *I, 3*

Lagrange's equations, holonomic and non-holonomic constraints, applications to dynamical systems, non-inertial systems, alternate formulations of mechanics, theory of small vibrations, variational principles, Hamiltonian formulation of dynamics, canonical transformations. (Lec. 3) *Prerequisite: PHY 421, 510.* Staff

521 Classical Dynamical Theory II *II, 3*

Poisson's brackets, infinitesimal contact transformations, Hamilton-Jacobi equation, action-angle variables, transition to quantum mechanics, special problems in dynamics. (Lec. 3) *Prerequisite: PHY 520.* Staff

522 Topics in the Physics of the Earth *II, 3*

Physics of the earth. Topics chosen from: elasticity, seismology, and the structure of the earth; terrestrial electricity, gravity, heat flow, magnetism, radioactivity, and tides; physics of the upper atmosphere. (Lec. 3) *Prerequisite: permission of department. In alternate years, next offered 1973-74.* Dietz

530 Electromagnetic Theory I *I, 3*

Coulomb's law, Gauss' law, scalar potential, boundary value problems, multipole expansion, dielectrics, magnetic field due to stationary currents, scalar and vector potential, magnetic materials, Faraday's law,

Lorentz force, conservation laws, Maxwell's equations. (Lec. 3) *Prerequisite: PHY 431, 510.* Staff

531 Electromagnetic Theory II I, 3

Scalar and vector wave equations and their solutions, retarded and advanced potentials, Lienard-Wiechert potentials, radiation from an arbitrarily moving charge, multipole radiation, wave guides, cavity resonators, plasma oscillations, theory of relativity. (Lec. 3) *Prerequisite: PHY 511, 530.* Staff

550 Physical Acoustics I, 3

Physical properties of gases, liquids and solids as revealed by the propagation of acoustic waves. Ultrasonic generation and measurement techniques, irreversible thermodynamics, mechanisms for absorption and dispersion of acoustic waves. (Lec. 3) *Prerequisite: permission of department.* Letcher

570 Quantum Mechanics I I, 3

Wave packets, Schrodinger equation, one-dimensional problems, hydrogen atom, harmonic oscillator, WKS approximation, operator formalism and matrix mechanics, angular momentum, perturbation theory, scattering and partial wave analysis, semiclassical treatment of the radiation field. (Lec. 3) *Prerequisite: permission of department.* Staff

571 Quantum Mechanics II II, 3

Dirac equation, spin orbit energy, theory of positrons, Feynman diagrams, Compton scattering, pair production and bremsstrahlung. Second quantization and application to selected topics. (Lec. 3) *Prerequisite: PHY 570.* Staff

580 Graduate Laboratory I and II, 3

Laboratory experiments designed to be performed by beginning graduate students. The laboratory will consist of a limited number of classic experiments to be completed with precision and thoroughness. Experiments will be selected primarily from the areas of atomic, nuclear and solid state physics. (Lab. 6) *Prerequisite: permission of department.* Quirk

585 Acoustic Measurements II, 1-2

Techniques for the measurement and analysis of sound in fluids and solids. (Lab. 3-6) *Prerequisite: permission of department.* Staff

590, 591 Special Problems I and II, 1-6 each

Advanced work under the supervision of a member of the staff and arranged to suit the individual requirements of the student. (Lec. or Lab. according to nature of problem) *Credits not to exceed 12. Prerequisite: permission of department.* Staff

599 Masters Thesis Research I and II

Number of credits is determined each semester in consultation with the major professor or program committee.

620 Statistical Mechanics I and II, 3

Kinetic theory of matter, Maxwell-Boltzmann distribution, collision and mean free path, the H-theorem,

Ergodic theorem, entropy, Nernst heat theorem, fluctuations and distributions, quantum statistics, ensemble theory, applications in nuclear physics, fluidity, condensation, electron theory of metals and relativistic gas. (Lec. 3) *Prerequisite: PHY 511, 570.* Staff

630 Electromagnetic Theory III I, 3

After developing the covariant formulation of electrodynamics, selected topics of current interest in electromagnetic theory such as accelerator design, etc., will be discussed. (Lec. 3) *Prerequisite: PHY 531.* Staff

650, 651 Solid State Physics I and II, 3 each

Quantum theory of electrons, phonons and other elementary excitations, Hartree-Fock approximation, many body problem, super conductivity, band theory and Fermi surface. (Lec. 3) *Prerequisite: PHY 455, 570.* Staff

660, 661 Nuclear Physics I and II, 3 each

General properties of the nucleus. Two body problem at low, intermediate and high energy. Three and four body problems, nuclear forces, special models, nuclear spectroscopy and reactions, decay of nuclei, many body problem, structure of nucleons. (Lec. 3) *Prerequisite: PHY 511, 571.* Staff

670, 671 Advanced Quantum Theory I and II, 3 each

Relativistic quantum field theory, free and interacting fields, the S-matrix and the perturbation expansion, quantum electrodynamics, dispersion relations, symmetry operations and invariance properties. (Lec. 3) *Prerequisite: PHY 571.* Staff

699 Doctoral Dissertation Research I and II

Number of credits is determined each semester in consultation with the major professor or program committee.

PLANT AND SOIL SCIENCE (PLS)

401, 402 Plant and Soil Science Seminar

I and II, 1 each

405 Propagation of Plant Materials II, 3

411 (or FRC 411) Soil Chemistry and Fertilizers I, 3

412 (or FRC 412) Soil Biochemistry II, 3

420 Crop Ecology I, 3

432 Commercial Floriculture II, 3

442 Professional Turfgrass Management II, 3

444 Environmental Aspects of Landscape Design II, 3

450 Soil Conservation and Land Use I, 3

- 454 Identification of Basic Ornamental Plants** II, 3 consultation with the major professor or program committee.
- 461 Weed Science** II, 3
- 468 Soil Genesis and Classification** I, 4
- 472 Plant Improvement** II, 3
- 475 Plant Nutrition and Soil Fertility** II, 3

491, 492 Special Projects and Independent Study
I and II, 1-3

PLANT PATHOLOGY-ENTOMOLOGY (PLP)

500 Growth and Development of Economic Plants II, 3

Factors affecting vegetative and reproductive growth and development of plants. Topics include growth regulators, auxins, environmental factors, dormancy, juvenility, vernalization and flowering. Term paper required. (Lec. 3) *Prerequisite: BOT 442. In alternate years, next offered 1974-75.* Shutak

501 to 504 (501, 502) Graduate Seminar in Plant and Soil Science I and II, 1 each

Presentation of technical reports and discussion of current research papers in soil science, landscape ecology, growth and development of economic crops and production and management of economic crops. (Lec. 1) *Prerequisite: permission of instructor. Fall 1973, PLS 501: Soil Science, Wright. Spring 1974, PLS 502: Landscape Ecology. Stuckey*

573 Post-Harvest Physiology of Economic Crops I, 3

Factors affecting post-harvest physiology of fruits, vegetables, flowers, ornamentals and sod. Influence of preharvest factors on post-harvest condition. Principles of preservation and storage. Individual or group projects. (Lec. 3) *Prerequisite: BOT 442 or equivalent. In alternate years, next offered 1974-75.* Shutak and Staff

576 Physiology of Plant Productivity I, 3

Critical analysis of contemporary views on energy conversion and transformation in primary plant production. Topics include photosynthesis, phosphorylation, photorespiration, transport mechanisms, carbohydrate and lipid metabolism, nitrogen assimilation and symbiosis. (Lec. 3) *Prerequisite: organic chemistry, plant physiology, biochemistry or with permission of instructor. In alternate years, next offered 1973-74.* Hull

591, 592 Non-thesis Research in Plant and Soil Science I and II, 1-3 each

Advanced work under supervision of research staff to expand research experience into areas other than those related to thesis research. Arranged to suit individual requirements. (Lab. 3-9) *Prerequisite: permission of department.* Staff

599 Masters Thesis Research I and II

Number of credits is determined each semester in

442 Diseases of Turfgrasses, Trees and Ornamental Shrubs II, 3

482 (582) Nematology II, 3

561 Plant Virology I, 3

Nature and properties of plant viruses, survey of plant diseases caused by viruses and experience in basic techniques. (Lec. 3) *Prerequisite: BOT 332 or equivalent. In alternate years, next offered 1973-74.* Mueller

591, 592 Research Problems I and II, 1-3 each

Individual or group study supervised by a faculty member in the fields of plant virology, nematology and disease mechanisms, economic entomology or plant pathology, agricultural and industrial mycology and related subjects. Written reports required for credit. (Lec. 1-3, Lab. 2-6) Staff

599 Masters Thesis Research I and II

Number of credits is determined each semester in consultation with the major professor or program committee.

611 The Nature of Plant Disease I, 3

Analysis of the nature of plant disease, the concepts of infection and pathogenesis, and the interaction of plant, pathogen, and environment in the disease process. (Lec. 3) *Prerequisite: BOT 332 or equivalent. In alternate years, next offered 1974-75.* Beckman and Mueller

699 Doctoral Dissertation Research I and II

Number of credits is determined each semester in consultation with the major professor or program committee.

Note: for other related courses see BOT 332, 432, 434 and ZOO 481, 482, 581, 586.

POLITICAL SCIENCE (PSC)

403 Government and Society of India and Pakistan I, 3

407 The Soviet Union: Politics and Society II, 3

408 African Government and Politics I, 3

- 411 The United States and China II, 3
- 420 Radical Change in the Modern Era II, 3
- 421 State and Local Government I, 3
- 431 International Relations I, 3
- 432 International Government II, 3
- 434 American Foreign Policy II, 3
- 443 Twentieth-Century Political Theory I, 3
- 455, 456 Directed Study or Research I and II, 3
- 460 Urban Politics I and II, 3
- 461 The American Presidency I, 3
- 464 International Law II, 3
- 466 Urban Problems II, 3
- 470 Problems and Principles in the American Political Process II, 3
- 471 Constitutional Law I, 3
- 472 Civil Liberties II, 3
- 481, 482 Political Science Seminar I and II, 3 each
- 483 Political Process: Policy Formulation and Execution I or II, 3
- 486 Intentional Communities II, 3
- 491 Principles of Public Administration I, 3
- 495 Comparative Urban Politics I, 3
- 498 Public Administration and Policy Formulation II, 3
- 501 Administrative Theory I and II, 3
Various theoretical constructs and models in the field of public administration, in particular the theories of Weber, Riggs, Dorsey, Simon, Presthus, as well as lower-level models in subfields of organization, communications, and decision-making. Students relate task-oriented subject matter such as personnel administration, budget administration and program administration to the theoretical formulations which seek to explain these activities. (Lec. 3) Prerequisite: PSC 491 or permission of department. Grossbard
- 502 Techniques of Public Management I and II, 3
Principles and techniques employed in the administration of staff activities of the public service such as administrative planning, project scheduling and budgeting. (Lec. 3) Prerequisite: PSC 491 or permission of department. Leduc
- 503 Problems in Public Personnel Administration I or II, 3
Development of personnel administration, including problems of recruitment, examination, promotion and staffing within public service. Emphasis on evaluation of employee performance and collective bargaining in public service. (Lec. 3) Prerequisite: graduate standing or permission of department. Grossbard
- 504 Politics of Developing Areas: Asia II, 3
Analysis of developments in newly independent, "third world" nations, particularly of Asia. Emerging political structures in relation to the processes of social, economic, and psychological change. (Lec. 3) In alternate years, next offered 1973-74. Stein
- 507 The U.S.S.R. and China in World Affairs I, 3
Comparative study of the foreign policies of the Communist nations. Examines continuity and change of Soviet policy in historic perspective, competitive coexistence with the West in the post-Stalin era, China's outlook on the world, the Sino-Soviet dispute, policy toward developing areas, international organization and arms control. (Lec. 3) Prerequisite: PSC 407 or permission of instructor. Stein
- 510 Developing Nation-State: Africa II, 3
Analysis of developmental policy formation with emphasis upon the governmental processes in the new nations with major focus on African countries. (Lec. 3) Prerequisite: permission of instructor. Milburn
- 512 Seminar in Marine Science Policy and Public Law II, 3
Multi-disciplinary teams of faculty and selected graduate students tackle unresolved problems in creating rules or institutions to cope with new uses of the marine environment, e.g., freedom of the seas, fisheries regulation, deep-sea mining, or weather modification. Team meetings at team convenience; plenary sessions; backup studies for team meetings plus final report. Prerequisite: permission of department. Staff
- 523 Seminar in Comparative Public Administration I, 3
Theory, practice, organization and operation of English and French administrative systems and their influence on newly established systems. Use of models, structure-function analysis and ecological analyses. (Lec. 3) Prerequisite: PSC 491, 501 or permission of department. Milburn
- 524 Seminar in Public Policy Problems I and II, 3
Exploration in depth of selected problems of policy formulation—intergovernmental relations, regionalization, citizen participation and control, priority setting for public sector programs. (Lec. 3) Prerequisite: PSC 491, 501 or permission of department. Grossbard
- 544 Democracy and Its Critics I, 3
Seminar examining the roots of modern democracy in the social contract theorists and analyzing the qual-

ity and limits of self-determination in these theories in the light of contemporary politics. (Lec. 3) *Prerequisite: PSC 341, 342, or permission of department.* Killilea

553 Scope and Methods of Political Science I, 3

Development of political science in relation to other social sciences. Political concepts, theories, and analytic systems surveyed in relation to the methodology. Latest trends and interests in the discipline. Research papers and reports explore individual problems. Required for graduate students. (Lec. 3) Sack

554 Advanced Research in Political Science II, 3

Fundamental concepts and techniques in political science with emphasis on advanced quantitative and qualitative analysis and the application of these methods to individual research projects. (Lec. 3) *Prerequisite: PSC 553 or permission of department.* Staff

555, 556 Directed Study or Research I and II, 3 each

Special work arranged to meet the individual needs of graduate students in political science. (Lec. 3) *Prerequisite: permission of department.* Staff

556 American Political Thought II, 3

Origins and development of American political thought. Intensive study, including European influences, of the growth of ideas about democracy in America. Locke, DeTocqueville, Jefferson, Lincoln, and other representative theorists. (Lec. 3) *Prerequisite: PSC 341, 342 or permission of instructor. In alternate years.* Wood

558 Jurisprudence II, 3

Introduction to the philosophy of law, treating the sources, the nature, and the consequences of major systems of legal thought. Emphasis on the relationship between legal reasoning and judicial decision-making in the United States. (Lec. 3) *Prerequisite: PSC 471, 472, or permission of instructor. In alternate years, next offered 1973-74.* Wood

572 Problems in International Relations I, 3

Examination of such major current problems in international relations as control of atomic energy, the flowering of nationalism in Asia, the role of the United Nations, western European problems, the problem of Germany and the role of ideologies in international relations. (Lec. 3) *Prerequisite: PSC 431 or permission of department.* Staff

578 International Law and Politics of the Oceans II, 3

Chronological view of interaction between political processes and resulting international law of the oceans. Special emphasis on international conferences on law of the sea. Open to graduate students in the Master of Marine Affairs Program and the Department of Political Science, and other graduate students with permission of instructor. (Lec. 3) Gamble

590 Internship in Public Administration I and II, 3-6

Participation in the activities of an administrative

agency under the joint supervision of the agency head and a member of the faculty gives the student direct knowledge of such fields as planning, personnel management, research organization, budgeting, interdepartmental relations, and the informal liaisons that are the hallmark of effective administration. May be taken as one 6-credit unit or two 3-credit units. *Prerequisite: permission of Bureau of Government Research.* Staff

595 Problems of Modernization in Developing Nations

See Resource Economics 595.

599 Masters Thesis Research I and II

Number of credits is determined each semester in consultation with the major professor or program committee.

PSYCHOLOGY (PSY)

410 Quantitative Methods in Psychology II I and II, 3

432 Advanced Development Psychology II, 3

434 Introduction to Psychological Testing I and II, 3

435 The Psychology of Social Behavior I and II, 3

445 Group Processes and Individual Behavior I and II, 3

460 The Psychology Violence and Aggression I and II, 3

461 Social and Psychological Aspects of Alcoholism I and II, 3

463 Psychology of Personal Meaning I or II, 3

479 Contemporary Problems for Modern Psychology I and II, 3-12

482 Psychobiology II, 3

489, 499 Problems in Psychology I and II, 3 each

510 Intermediate Quantitative Methods II, 3

Complex statistical techniques useful in practical psychological research including multiple correlation and regression analysis, multiple correction for restriction in range, and introductory multivariate analysis methods. (Lec. 3) *Prerequisite: permission of department.* Merenda and Cain

520 Psychometric Methods I or II, 3

Techniques for investigating areas of attitude and opinion research, morale and leadership, personality and perception. Includes techniques of test construction, Q-methodology, and psychometric scaling. (Lec. 3) *Prerequisite: PSY 434, 510. In alternate years.* Merenda and Staff

532 Experimental Design
See Experimental Statistics 532.

534 Clinical Interpretation of Standardized Psychological Tests *II, 3*
Clinical use of standardized assessment techniques such as MMPI. Critical review of theory and research underlying objective, group assessment of human characteristics. Development and interpretation of individualized evaluations based on profile analysis. (Lec. 3) *Prerequisite: PSY 434.* Berman and Staff

542 The Exceptional Child *I or II, 3*
Definition and proper classification of types of exceptional children, and the social, psychological, and physical factors involved. Problems of rehabilitation and psychological treatment of the exceptional child. Types of exceptional children such as superior, retarded, physically handicapped, and those suffering from developmental aberrations. (Lec. 3) *Prerequisite: PSY 232, 254 and permission of department.* Weiner

550 (or PCL 550) Operant Analysis of Behavior *I or II, 3*
Introduction to the principles of operant conditioning with emphasis on the use of these principles in the analysis of behavior. (Lec. 3) *Prerequisite: permission of department.* Smith and Lal

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

600 Advanced General Psychology *I or II, 3-15*
A series of courses that provide incoming graduate students with an intensive preparation in the major areas of general psychology: (a) psychophysiology, (b) learning, (c) cognition and perceptual processes, (d) developmental, (e) social. (Lec. 3) *May be repeated up to five times. Prerequisite: permission of department.* Staff

610 (or EST 610) Factor Analysis *II, 3*
Study of and comparison among various procedures of factor analysis including tetrad differences, bi-factor, group centroid, principal components and canonical methods. Interpretation of factors. Estimation of factor loadings and specific variances. Methods for factor rotation. Estimation of factor scores. (Lec. 3) *Prerequisite: EST 541. In alternate years, next offered 1973-74.* Merenda

611 Methods of Psychological Research and Experimental Design *I or II, 3*
Provides the student of psychology with a knowledge of research methodology and the techniques of experimental designs. It prepares for the development of thesis problems of graduate students in psychology and related disciplines. (Lec. 3) *Prerequisite: PSY 510, 532. In alternate years, next offered 1973-74.* Merenda

616 Methodology and Design in Research in School Psychology *I or II, 3*
Models of research design and methodology particularly applicable to the school situation are explored. (Lec. 3) *Prerequisite: PSY 510, 532, permission of department.* Staff

617 Methodology and Design in Research in Clinical Psychology *I or II, 3*
Models of research design and methodology particularly pertinent to the area of clinical psychology with emphasis on mental designs appropriate to research problems, using specific experiments and original research. (Lec. 3) *Prerequisite: PSY 510, 532, permission of department.* Biller

620 Seminar: Classical Conditioning *I and II, 3*
History and nature of the conditional reflex, with emphasis placed on understanding the role of the conditional reflex and contemporary behavioral research and theory. (Lec. 3) *Prerequisite: permission of department.* Smith

621 Seminar: Human Learning and Memory *I or II, 3*
Experimental analysis of major problem topics of learning and retention studies in humans. Emphasis on systematic studies of verbal habits, dimensional analysis of the critical variables influencing these habits, and the interference theory of forgetting. (Lec. 3) *Prerequisite: permission of department.* Silverstein

640 Personality Dynamics I (Advanced Personality) *II, 3*
Readings from the original sources of the major contemporary personality theorists. Emphasis on the possible integration of these theories, and the development of syncretic theory according to individual preferences. (Lec. 3) *Prerequisite: permission of department. In alternate years, next offered 1973-74.* Cain

660 Personality Dynamics II (Advanced Psychopathology) *I or II, 3*
Study of empirical literature with regard to etiological factors involved in the formation of pathological character trends and deviations. Evaluation of clinical theory and classification systems as related to the psycho-therapeutic process. (Lec. 3) *Prerequisite: permission of department.* Prochaska

661 Psychological Services I (Administration and Interpretation of Cognitive Tests) *I, 3*
Instruction and practice in the administration and interpretation of cognitive tests; individual intelligence tests of both general and specific abilities. Seminar underlying rationale, research evidence and clinical application of such tests as Stanford-Binet, Wechsler, Bender-Gestalt, Lister International. *Laboratory practicum.* (Lec. 3) *Prerequisite: permission of department.* Richardson and Staff

662 Psychological Services II (Administration and Interpretation of Personality Tests) *II, 3*
Instruction and practice in the administration and

interpretation of instruments used in the assessment of personality. Emphasis upon projective tests such as Rorschach, TAT. Seminar underlying rationale, research evidence and clinical application. (Lec. 3) *Prerequisite: permission of department.* Richardson and Staff

563 Seminar to Accompany Field Experience in Psychological Services *I and II, 3*

All students meet in seminar to discuss and investigate specific diagnostic, therapeutic, research problems emerging in connection with internship experience. (Lec. 3) *Prerequisite: PSY 670* Staff

664 Advanced Diagnostic Problems *I or II, 3*

Use and interpretation of cognitive, projective, and neural psychological tests. Focus on integrated data into meaningful description of total personality functioning. Use of the diagnostic interviewer. (Lec. 3) *Prerequisite: PSY 640, 660, 661, 662 and permission of instructor. In alternate years.* Berman

565 Seminar: Behavior Disorders in Childhood *I or II, 3*

Emphasis on etiological factors, diagnostic and treatment consideration, and experimental research findings related to the psychological maladjustments in infancy and childhood; treatment procedures, resources and methods used in dealing with behavior and personality problems. Lectures, discussions, and case demonstrations. (Lec. 3) *Prerequisite: PSY 660. In alternate years, next offered 1973-74.* Berman

666 Seminar: The Professional Psychologist in the Community *I and II, 3*

Ethical and professional standards related to the practice of psychological services. Discussion and guest lectures by members of related disciplines. Special emphasis upon the role of the professional psychologist in the community: (a) clinical psychology, (b) school psychology. (Lec. 3) *Prerequisite: permission of department.* Staff

670 Field Experience in Psychological Service *I and II, 6-12*

Training placements and internships are available in a variety of institutional agencies and school settings under supervision which must be acceptable to the department. *Prerequisite: equivalent of 1 year full-time graduate work, clinical practices sequence, permission of department.* Staff

671 Clinical Practices I (Diagnostic) *I or II, 3*

Supervised practice in the assessment of problem behavior. Emphasis on the integration of data from psychological tests, case histories, and other sources in the assessment of personality. Practicum facilities available in several agencies. (Lec. 2, Lab. 2) *Prerequisite: PSY 661, 662, and permission of department. In alternate years, next offered 1973-74.* Berger

672 Individual Clinical Practicum *I or II, 3-9*

Introductory experience in dealing with clinical prob-

lems in a variety of clinical settings. Individual supervision to be arranged. (Lec. 3) *May be repeated up to three times. Prerequisite: PSY 661, 662 and permission of department.* Staff

673 Seminar: Introduction to Clinical Psychotherapy *I, 3*

Theories and techniques of psychotherapeutic procedures involving directive and nondirective and play therapies. Theoretical rationale and empirical research with special emphasis on the child area. (Lec. 3) *Prerequisite: permission of department.* Willoughby

674 Clinical Practices II (Therapy) *I or II, 3-21*

Specialized practices and techniques of clinical interviewing, counseling, and psychotherapy with children and adults. Observations, reading, and model tapes supplement critical discussions of the student's own supervised therapy sessions: (a) individual, (b) behavior, (c) group, (d) sensitivity, (e) family, (f) child-play, (g) specialized techniques. (Lec. 3) *May be repeated up to seven times. Prerequisite: PSY 640, 660, 673, and permission of department.* Staff

675 Experimental Psychopathology *I or II, 3*

Relates recent experimental methodology and findings to prevalent theoretical positions. Emphasis on reviewing experimental literature in specialized clinical areas. (Lec. 3) *Prerequisite: permission of department.* Prochaska

676 Neurological Correlates of Psychopathology *I and II, 3*

Functioning and physiology of central nervous system with particular attention to determining how neurological disruption and injury are manifested in behavioral disorder. Techniques used to evaluate and interpret neuropsychological functioning. (Lec. 3) *Prerequisite: permission of instructor.* Berman

678 Seminar: Physiology of Learning and Memory *II, 3*

Examination of theories of learning and memory in terms of biochemical changes and neurological processes. Neuroanatomy and function of higher brain systems are reviewed and related to learning and memory processes. (Lec. 3) *Prerequisite: PSY 381 or permission of instructor. In alternate years, next offered 1973-74.* Swonger

680 School Practices I (Diagnostic) *I and II, 3-9*

Testing procedures and devices in the diagnosis of organicity, personality problems and devices in the diagnosis of organicity, personality problems, special learning problems, visual, auditory, and memory problems; includes administration, interpretation, and special adaptation of tests in the school situation. (Lec. 3) *May be repeated up to three times. Prerequisite: PSY 434, 661 and permission of department.* Staff

681 Special Problems in School Psychology *I or II, 3-9*

Role of the psychologist in the school setting. Several

theoretical and practical issues concerned with the value of psychological theory, administrative philosophy, and school organization are explored. (Lec. 3) May be repeated up to three times. Prerequisite: PSY 680 and permission of department. Vosburgh, Staff

682 Individual Practicum in School Psychology

I or II, 3-9

Designed to accompany the student's internship in the school setting. Techniques for adapting psychological services to function within the school system. Individual supervision to be arranged. (Lec. 3) May be repeated up to three times. Prerequisite: permission of department. Vosburgh

683 Psychology of the Exceptional Child

I, 3

Social, psychological and educational factors that constitute the matrix of concerns with the exceptional individual in the school and community. Attention given to recent innovations in public and private education and habilitation. Research issues and legislation discussed will evolve into student studies. (Lec. 3) Prerequisite: permission of department. Weiner and Staff

684 Learning Disabilities

I, 3

Introduction to developments in the field of disorders of learning in the school-age child, stressing recent conceptualizations of underlying psychological parameters essential to basic processes involved in learning. Interdisciplinary approaches to diagnosis discussed and the innovation of prescriptive teaching introduced. (Lec. 3) Prerequisite: PSY 683 and/or permission of instructor. Gross

685 Psychology of Mental Retardation

II, 3

Etiological factors, including biogenetic, physiological and social origins of mental retardation. The epidemiology and ecological aspects considered as they interact with social and cultural forces. Historical and current philosophy of habilitation and education of school-age children and adults. (Lec. 3) Prerequisite: permission of instructor. Weiner and Staff

686 Psychology and Education of the Emotionally Disturbed

I, 3

Current thinking on treatment and education of residential and day-care programs for the emotionally disturbed. Meaning of the various concepts of schizophrenia, autism and hyperkinetic impulse disorder for treatment. Application of operant techniques for shaping socially appropriate behavior. Overview of origins of current operant methods in hospitals and schools. (Lec. 3) Prerequisite: permission of instructor. Gross

690 Seminar: Contemporary Issues in Psychology

I and II, 3-12

Recent developments and current issues. Rigorous exploration of experimental and theoretical literature. Study limited each semester to one of the following areas: developmental, clinical, motivation, perception, psychophysics, and scaling problem solving and thinking. A maximum of 4 seminars may be taken. (Lec. 3) Prerequisite: permission of department. Staff

691 Individual Practicum in Teaching Psychology

I or II, 3-6

Seminar and supervised experience in the teaching of psychology primarily at the undergraduate level. Students will be involved in laboratory and discussion groups under supervision. (Lec. 3) May be repeated up to two times. Prerequisite: permission of department. Camp and Staff

692, 693 Directed Readings and Research Problems

I or II, 3-6 each

Directed readings and advanced research work under the supervision of a member of the staff arranged to suit the individual requirements of the students. Prerequisite: permission of department. Staff

694 Special Problems in Clinical Psychology

I or II, 3-12

Instruction and clinical practicum training in unique problem areas of clinical psychology. Development of specialized evaluation instruments and procedures. (Lec. 3) May be repeated up to four times. Prerequisite: permission of department. Staff

699 Doctoral Dissertation Research

I and II

Number of credits is determined each semester in consultation with the major professor or program committee.

RESOURCE ECONOMICS (REN)

430 International Resource Development

II, 3

441 Economics of Food Marketing

I, 3

450 Resource Policy and the Environment

II, 3

491, 492 Special Projects

I and II, 3 each

514 Economics of Marine Resources

I, 3

The role of economics in development of marine resources. Particular attention to problems of multiple use of resources and to the conflicts between private and public goals. (Lec. 3) Prerequisite: M.M.A. students or permission of instructor. Rorholm

527 Macroeconomic Theory

See Economics 527.

528 Microeconomic Theory

See Economics 528.

532 Land Resource Economics

See Community Planning 532.

534 Economics of Resource Development I

II, 3

Economic theory applied to the development of human and natural resources with topics drawn from current resource use problems. Analytical techniques treated are simulation techniques, cost-benefit analysis, input-output models, growth models. Cobb-Douglas functions, and Markov chains. (Lec. 3) Prerequisite:

site: REN 532 and ECN 528 or equivalent, or permission of instructor. Gates

543 Economic Structure of the Fishing Industry I, 3
Analysis of U.S. and world fishing industries from standpoint of activity and efficiency. Problems related to common property resources, government policy, labor, and legal and institutional factors will be covered. (Lec. 3) *Prerequisite:* ECN 427 and 428 or permission of instructor. Holmsen

550 The Economics of Exhaustible Marine Resources II, 3
Theory and application of natural resource analysis specifically applied to such marine resources as petroleum, sand and gravel, manganese, and other minerals. (Lec. 3) *Prerequisite:* ECN 328 or permission of instructor. Grigalunas

576 Econometrics I I, 3
See Economics 576.

577 (or EST 577) Econometrics II II, 3
Continuation of Econometrics I. (Lec. 3) *Prerequisite:* REN 576. Lampe

595 (or ECN 595, GEG 595, PSC 595 or SOC 595) Problems of Modernization in Developing Nations II, 3
Varying regional emphasis. Selected problems in the environmental complex, agricultural systems, population dynamics, distribution systems, political integration, urbanization-industrialization, popular participation, integrated theories of modernization. (Lec. 3) *Prerequisite:* permission of instructors. Brand (Geography), Weaver (Resource Economics), Landberg (Sociology and Anthropology), Milburn (Political Science), and Suzawa (Economics)

599 Masters Thesis Research I and II
Number of credits is determined each semester in consultation with the major professor or program committee.

602 Research Methodology I and II, 3
Evaluation of alternative research methods and techniques. Development of specific research projects. (Lec. 3) Hueth

610 Advanced Studies I and II, 3
Advanced topics in resource economics. Mathematical models in resource management. May be repeated for different topics. (Lec. 3) Staff

621 The Estuary and Coastal Zone
See Oceanography 621.

634 Economics of Resource Development II I, 3
Concepts of economic efficiency applied to natural resources with emphasis on marine resources. Application of welfare and institutional economics to resource development; analysis of optimum allocation among users. (Lec. 3) *Prerequisite:* REN 534. Cummings

635 Marine Resources Policy I, 3
Analysis of public policy problems relating to the development and management of marine resources, including fisheries, minerals, petroleum, water and recreation. (Lec. 3) *Prerequisite:* REN 534. Norton

675 Mathematical Economics II, 3
Application of mathematical tools to problems in micro- and macroeconomics. Mathematical treatment of models of consumption, production, market equilibrium and aggregate growth. (Lec. 3) *Prerequisite:* ECN 627 and 628. Norton

699 Doctoral Dissertation Research I and II
Number of credits is determined each semester in consultation with the major professor or program committee.

RESOURCE MECHANICS (REM)

451 Soil Conservation Technology I, 3

484 Structures II, 3

RUSSIAN (RUS)

460, 461 The Russian Novel I and II, 3 each

497, 498 Directed Study I and II, 3 each

901, 902 Reading Course in Russian for Graduate Students I and II, 0 each
901: Fundamentals of grammar and syntax necessary to develop reading knowledge. Assumes no prior knowledge of Russian. 902: Exercises in translating scholarly and scientific texts. Staff

SOCIOLOGY (SOC)

408 Industrial Sociology I, 3

410 Complex Organizations in Modern Society II, 3

412 Occupations, Professions, and Social Structure I and II, 3

414 Demography I or II, 3

416 Seminar in Criminology II, 3

420 Sociology of the Environment II, 3

430 Social Pathology and Social Change I, 3

432 Ecology of the Community I or II, 3

434 Urban Sociology I, 3

436 Sociology of Politics II, 3

438 Aging and Society *I, 3***440 Sociology of Mental Illness** *I and II, 3***442 Sociology of Education** *I and II, 3***444 Sociology of Religion** *I and II, 3***446 Sociology of Knowledge** *I and II, 3***448 Sociology of Science** *I and II, 3***492 History of Sociological Thought** *I, 3***496 Advanced Sociological Research** *II, 3*

502 Contemporary Sociological Theory *II, 3*
 Critical examination of the theories and systems of contemporary sociologists. (Lec. 3) *Prerequisite: 12 credits of sociology or permission of instructor.* Gardner

508 Individual and Social Organization *I or II, 3*
 Sociology of the individual as the creator, preserver, and participant in society. Emphasis upon symbolic interaction in the growth of personal idiom, the development of social structure, and of the content of social change. (Lec. 3) *Prerequisite: permission of department.* Staff

510 Seminar in Deviance *I or II, 3*
 Deviation from social expectations analyzed as a social phenomenon. Emphasis on deviation theories and research pertaining to individuals, subcultures, and social systems. Discussions, oral and written reports. (Lec. 3) *Prerequisite: permission of department.* Staff

512 Concepts of Social Structure *I or II, 3*
 Examination of key spheres in social organization such as stratification, institutions, communities from a variety of perspectives including consensus and coercion models, pluralist versus elitist images of power structure, and the pros and cons of functionalism. (Lec. 3) *Prerequisite: permission of department.* Staff

514 Issues and Problems of Bureaucracy *II, 3*
 Classical and modern theory, research and current problems in the sociology of bureaucratic organizations. Analysis of case studies, field research, and critiques. (Lec. 3) *Prerequisite: graduate standing and/or permission of instructor.* Rosengren

571, 572 Seminars *I and II, 3 each*
 Designed to cover areas of special research interests of graduate students not covered in other courses. (Lec. 3) *Prerequisite: permission of department.* Staff

595 Problems of Modernization in Developing Nations
 See Resource Economics 595.

599 Masters Thesis Research *I and II*
 Number of credits is determined each semester in consultation with the major professor or program committee.

SPANISH (SPA)**407 Intensive Practice in Conversation** *I, 3***408 Conversation and Teaching Materials** *I, 3***409 History of the Spanish Language** *II, 3***430 Castilian Literature of the Sixteenth and Seventeenth Centuries** *II, 3***450 Neo-Classicism and Romanticism** *I, 3***451 The Spanish Novel of the Nineteenth Century** *I, 3***461 The Generation of 1898** *I, 3***462 Contemporary Spanish Writers** *II, 3***471, 472 Introduction to Hispanic-American Literature** *I and II, 3 each***481 Don Quijote** *I, 3***483 The Origins of the Novel in Spain** *I, 3***485 The Modern Spanish Novel** *II, 3***488 The Drama of the Golden Age** *II, 3***495 Hispanic Civilization** *II, 3***497, 498 Directed Study** *I and II, 3 each*

511 Spain during the Reconquest *I, 3*
 Prominent features of medieval Spanish civilization reflecting the convergence of Christians, Muslims and Jews. Selected readings from epic, lyric, and prose writings. (Lec. 3) *Prerequisite: graduate status or permission of instructor. In alternate years, next offered 1973-74.* Navascués

512 Spanish Literature of the Fifteenth Century *II, 3*
 Folk ballads and courtly poetry as well as prose writings reflecting the rise of new cultural currents. (Lec. 3) *Prerequisite: graduate status or permission of instructor. In alternate years, next offered 1973-74.* Navascués

573 Modern Hispanic-American Poetry *I, 3*
 Hispanic-American poetry from the last two decades of the nineteenth century to the present day: a critical study with special attention to Martí, Darío, González Martínez, Gabriela Mistral, Ibarbourou and Neruda. (Lec. 3) *Prerequisite: graduate status or permission of instructor. In alternate years, next offered 1974-75.* Navascués

574 Hispanic-American Novel *II, 3*
 Hispanic-American novel with particular emphasis on its trends in the twentieth century. The works of such writers as Isaacs, Cambaceres, Azuela, Arguedas, Gallegos, Mallea, Asturias and Fuentes will be analyzed. (Lec. 3) *Prerequisite: graduate status or per-*

mission of instructor. In alternate years, next offered 1974-75. Navascués

- 582 Cervantes: Theater and Novels** II, 3
The reading and critical interpretation of selections from *Comedias* and *Entremeses*, *Las novelas ejemplares*, *La Galatea*, *Persiles y Sigismunda*. (Lec. 3) *Prerequisite: graduate status or permission of instructor. In alternate years, next offered 1974-75.* Hutton

- 583 The Spanish Baroque** I, 3
Study and analysis of *Culteranismo* and *Conceptismo* in Gongora, Quevedo and Gracián. (Lec. 3) *Prerequisite: graduate status or permission of instructor. In alternate years, next offered 1974-75.* Kossoff

- 584 Spanish Problematic Literature** II, 3
Development of Spanish thought particularly with respect to sociological and cultural problems from the eighteenth century to the contemporary period as seen through the writings of significant essayists. (Lec. 3) *Prerequisite: graduate status or permission of instructor. In alternate years, next offered 1973-74.* Hutton

- 591 Introduction to Research and Criticism** I, 3
Introduction to scholarly research and literary criticism. Required as the first course for all candidates for the M.A. in Spanish. (Lec. 3) *Prerequisite: graduate status or permission of instructor.* Kossoff

- 592 Religious Sources of Hispanic Literature** II, 3
Significance of religion in Iberian culture and its reflection in major literary works. (Lec. 3) *Prerequisite: graduate status or permission of instructor. In alternate years, next offered 1973-74.* Hutton

- 594 Seminar in Spanish Literature** I and II, 3
Research and analysis of a particular author or problem of Spanish or Hispanic-American literature. (Lec. 3) *Prerequisite: graduate status or permission of instructor.* Staff

- 599 Masters Thesis Research** I and II
Number of credits is determined each semester in consultation with the major professor or program committee.

SPEECH (SPE)

- 400 Rhetoric** I, 3
410 Semantics II, 3
417 Speech in the Elementary School I and II, 3
433 Chamber Theatre I, 3
471 Internship in Speech Communication I or II, 3
491, 492 Special Problems I and II, 1-3 each
504 Speech and Hearing Research I, 3
Types of research in speech pathology, audiology, and communication science; critiques of representative

models with special emphasis on experimental research; individual pilot projects or master's thesis. (Lec. 3) *Prerequisite: admission to graduate programs in speech, or permission of instructor.* Grubman

- 551 Measurement of Hearing** I, 2
History of hearing evaluation techniques; methods and practicum in basic audiological assessment; types of hearing losses and their implications for rehabilitation. (Lec. 2) Jirsa or Arnst

- 552 Advanced Measurement of Hearing** II, 2
Speech audiometry; recruitment phenomena; functional hearing losses; education and rehabilitation problems associated with electronically assisted hearing. (Lec. 2) *Prerequisite: SPE 551 or equivalent.* Jirsa or Arnst

- 553 Pedaodiology** I, 2
Hearing evaluation problems associated with infants and preschool children; instrumentation and procedures; behavioral characteristics of hearing-impaired children. (Lec. 2) Arnst

- 554 Auditory Training and Speechreading** II, 2
Rationale and techniques for auditory training programs; speechreading as a communication system; evaluation of methodologies for developing speechreading skills; practicum with children and adults. (Lec. 2) *Prerequisite: SPE 551 or permission of instructor.* Arnst

- 555 Electronically Assisted Hearing** I, 2
Principles of selective amplification and acoustical control; evaluation of various devices including wearable hearing aids; methods of instruction in the use of acoustical instruments. (Lec. 2) *Prerequisite: SPE 552 or permission of instructor.* Jirsa or Arnst

- 556 Automatic Audiometry** II, 2
Bekesy principle; continuous, discrete, and pulsetone measurements; diagnostic implications of various type tracings; research findings and current issues; practicum. (Lec. 2) *Prerequisite: SPE 552 or permission of instructor.* Regan

- 561 Disorders of Articulation** I, 2
Types and causes of articulation disorders; rationale for case selection; S-R-L syndrome; special emphasis on rehabilitation procedures associated with individual involvements; practicum. (Lec. 2) Grubman or Staff

- 562 Disorder of Voice** I, 2
Type and causes of voice disorders; rationale for case selection; medical implications; special emphasis on rehabilitation procedures associated with individual involvements; practicum. (Lec. 2) Beaupre

- 563 Disorders of Rate and Rhythm** II, 2
Types and causes of rate, rhythm and stress disorders; rationale for case selection; survey of stuttering theories, special emphasis on rehabilitation procedures associated with individual involvements; practicum. (Lec. 2) FitzSimons

- 564 Disorders of Symbolization** II, 2
 Types and causes of language symbolization disorders; rationale for case selection; childhood aphasia and autism; special emphasis on rehabilitation procedures associated with individual involvements; practicum. (Lec. 2) Grubman
- 565 Diagnostic Procedures: Voice and Articulation** I, 2
 Instrumentation, tests, and procedures for evaluating individuals with voice and articulation disorders; practicum in speech and hearing centers; principles of differential diagnosis and report writing. (Lec. 2) *Prerequisite: permission of instructor.* Grubman
- 566 Diagnostic Procedures: Rhythm and Symbolization** II, 2
 Instrumentation, tests, and procedures for evaluating individuals with disorders of rate, rhythm and symbolization; problems in differential diagnosis; practicum in speech and hearing centers. (Lec. 2) *Prerequisite: permission of instructor.* FitzSimons
- 567 Clinical Practicum in Speech Pathology** I and II, 1-3
 Supervised diagnostic and therapeutic procedures with persons experiencing communicative disorders. Differential diagnosis, parent counseling, and cooperation with allied personnel. Practicum held on campus and within institutional and school settings. (Lab. 3-9) *Prerequisite: permission of adviser.* Staff
- 568 Clinical Practicum in Audiology** I and II, 1-3
 Supervised clinical practicum concerned with audiological assessment of hearing disorders and auditory rehabilitation with the hearing impaired. Practicum held on campus and within institutional and school setting. (Lab. 3-9) *Prerequisite: permission of adviser.* Staff
- 571 Audiometric Screening and Surveying Techniques** I, 3
 Rationale, instrumentation, and techniques for selecting and administering group and individual screening tests; records and interpretations; current research and professional issues. (Lec. 3) *Prerequisite: admission to graduate program in audiology.* Jirsa or Arnst
- 572 Medical Audiology** II, 3
 Diagnostic implications of audiometry for various organic disorders; supportive audiological information relevant to medical and surgical interventions; differential data associated with otosclerosis, Meniere's disease, VIIIth cranial nerve tumors, and malingerers. (Lec. 3) *Prerequisite: admission to graduate program in audiology.* Jirsa or Arnst
- 573 Contemporary Problems in Audiology** I, 3
 Critical review of current research and controversial issues within the profession; student selects one topic for independent study. (Lec. 3) *Prerequisite: admission to graduate program in audiology and permission of instructor.* Jirsa or Arnst
- 574 Environmental Audiology** II, 3
 Hearing problems in industry, in the military, and other high noise level environments; medico-legal aspects of hearing loss; hearing conservation programs in public schools. (Lec. 3) *Prerequisite: admission to graduate program in audiology or permission of instructor.* Jirsa
- 575 Speech and Language for Deaf or Hard of Hearing Child** I, 3
 The audiologist as hearing therapist in public school settings, medical clinics, and pre-school programs; responsibilities as part of the educational, psychological and medical team for active intervention with speech and language problems. (Lec. 3) *Prerequisite: admission to the graduate program in audiology or permission of instructor.* Arnst
- 576 Speech and Language for Deaf or Hard of Hearing Adult** II, 3
 The audiologist as hearing therapist and consultant for adults with agenerative or degenerative hearing deficits; responsibilities as part of the rehabilitation team for active intervention with speech and language problems. (Lec. 3) *Prerequisite: admission to graduate program in audiology or permission of instructor.* Arnst
- 581 Cerebral Palsy** I, 3
 Identification of types of cerebral palsy by location of lesion, motor symptomatology and additional handicaps; role of the speech clinician on the team; types of speech therapy with emphasis on the Bobath approach; current research and controversial issues. (Lec. 3) *Prerequisite: admission to graduate program in speech pathology.* Staff
- 582 Stuttering and Cluttering** II, 3
 Analysis of the various etiological theories of stuttering and tachyphemia; techniques and implications of the several therapies; developing a rationale for intervention and case selection. (Lec. 3) *Prerequisite: admission to graduate program in speech pathology.* FitzSimons
- 583 Cleft Palate and Other Orafacial Deformities** I, 3
 Relationship of prosthetic, surgical, and orthodontic intervention to speech rehabilitation; role of speech clinician on the cleft palate team; assessment of therapeutic approaches; current research and controversial issues. (Lec. 3) *Prerequisite: admission to the graduate program in speech pathology or permission of instructor.* Grubman
- 584 Delayed Speech and Language** II, 3
 Problems in differential diagnosis for deafness, aphasia, autism, and learning disorders; demonstrations and critiques of clinical interventions with children who have speech and language learning deficits including dyslexia and acalculia. (Lec. 3) *Prerequisite: admission to the graduate program in speech pathology.* FitzSimons

585 Aphasia and Allied Language Disorders I, 3

Types of adult aphasia; central and peripheral dysarthrias; role of speech clinician on the rehabilitation team; other degenerative disorders such as Parkinsonism and dystonia; current research and controversial issues. (Lec. 3) *Prerequisite: admission to graduate program in speech pathology or permission of instructor.* Grubman or Beaupre

586 Alaryngeal Speech II, 3

Voice and speech rehabilitation for individual without a functional larynx; social, emotional and medical considerations; clinical procedures for esophageal, pharyngeal and buccal speech; implications for use of artificial larynx; current research. (Lec. 3) *Prerequisite: admission to graduate program in speech pathology.* Beaupre

599 Masters Thesis Research I and II

Number of credits is determined each semester in consultation with the major professor or program committee.

STATISTICS

Management Science

501, 502 Advanced Business Statistics
981 Fundamental Business Statistics

Experimental Statistics (Computer Science and Experimental Statistics)

411 Statistical Methods in Research I
412 Statistical Methods in Research II
500 Nonparametric Statistical Methods
511 Linear Statistical Models
520 Fundamentals of Sampling and Applications
532 (or ASC 532) Experimental Design
541 Multivariate Statistical Methods
576 (or ECN 576, REN 576) Econometrics I
577 (or ECN 577, REN 577) Econometrics II
591, 592 Problems in Experimental Statistics
610 (or PSY 610) Factor Analysis
635 (or IDE 635) Response Surfaces and Evolutionary Operations

Industrial Engineering

411 Engineering Statistics I
412 Engineering Statistics II
633 Advanced Statistical Methods for Research and Industry
634 Design and Analysis of Industrial Experiments
635 (or EST 635) Response Surfaces and Evolutionary Operations

Mathematics

451 Introduction to Probability and Statistics
452 Mathematics Statistics
456 Probability
550 Advanced Probability
551 Advanced Mathematical Statistics I
552 Advanced Mathematical Statistics II

Psychology

410 Quantitative Methods in Psychology II

510 Intermediate Quantitative Methods in Psychology
610 (or EST 610) Factor Analysis

TEXTILES AND CLOTHING (TXC)

405 Advanced Clothing I and II, 3

406 Housing Planning I, 3

422 Retail Experience I and II, 3

433 Textiles and Clothing Industry I and II, 3

440 Historic Textiles I, 3

502 Seminar in Textiles and Clothing I and II, 3

Original investigations in the area of clothing problems. (Lec. 3) Carpenter

503 (403) Advanced Textiles I and II, 3

Analysis of fabrics; methods and techniques of testing fabrics; evaluation of fabric data in relation to end-use performance and to existing quality standards. (Lec. 2, Lab. 2) *Prerequisite: TXC 303.* Helms

524 (424) Seminar in Textiles and Clothing II, 3

Literature in the field of textiles and clothing, review of research for textiles and clothing problems. (Lec. 3) Carpenter

533 Textile and Clothing Economics I and II, 3

The economic development of production and distribution of textiles and clothing. (Lec. 3) Staff

540 Special Problems in Textiles and Clothing I and II, 3

Supervised independent study in specific areas of textiles and clothing. Staff

550 Seminar and Practicum I and II, 3

Professional role of the textiles and clothing specialist. *Prerequisite: permission of department.* Staff

560 Special Problems in Textiles and Clothing I and II, 3

Supervised independent study in specific areas of textiles and clothing. Staff

570 Seminar in Textiles and Clothing Research I and II, 3

Critical study of research literature and research techniques. *Prerequisite: permission of department.* Staff

580 Research Methods in Textiles and Clothing I and II, 3

Development and execution of research in textiles and clothing following the historical, descriptive, and experimental methods. Analysis of current research in the field. (Lec. 2, Lab. 2) Carpenter

599 Masters Thesis Research I and II

Number of credits is determined each semester in consultation with the major professor or program committee.

THEATRE (THE)

- 410 Advanced Acting 1 and II, 1-3
- 420 Advanced Directing Practice 1 and II, 1-3
- 440 Advanced Stage Management 1 and II, 1-3
- 450 Advanced Costuming 1 and II, 1-3
- 460 Advanced Scene Design 1 and II, 1-3
- 470 Advanced Stage Lighting 1 and II, 1-3
- 482 Contemporary Theatre 1, 3

amination of electron micrographs. (Lec. 3, Lab. 3) *Prerequisite: ZOO 315. In alternate years.* Goertemiller

531 Advanced Parasitology Seminar 1, 2
Advanced topics in the host-parasite relationships of protozoan and metazoan parasites. Reading knowledge of one foreign language assumed. Topics vary from year to year. (Lec. 2) *Prerequisite: ZOO 331 or equivalent. In alternate years.* Hyland and Zinn

new 541, 542 Comparative Physiology 1 and II, 3 each
A comparison of the physiological mechanisms by which animals maintain life with emphasis on marine invertebrates. (Lec. 2, Lab. 3) *Prerequisite: ZOO 345 and 354. ZOO 541 is not prerequisite for ZOO 542. ZOO 541: Responses to the external environment mediated by receptors, nervous systems, and effectors. Living control systems for muscular activity and for circulation. Hill ZOO 542: Processes related to maintenance of the internal environment, including osmotic balance, gaseous exchange and transport, nutrition, intermediary metabolism, nitrogen excretion, shell formation.* Hammen

ZOOLOGY (ZOO)

- 421 Principles of Taxonomy 1, 3
- 427 (or MCE 427) Modelling and Analysis of Dynamic Systems 1, 3
- 441 General (Cellular) Physiology 1, 3
- 442 Mammalian Physiology II, 3
- 455 (or BOT 455) Marine Ecology 1, 3
- 457 (or BOT 457) Marine Ecology Laboratory 1, 1
- 463 Animal Ecology II, 3
- 465 Limnology 1, 3
- 466 Vertebrate Biology II, 3
- 467 Animal Behavior II, 3
- 468 Mammalogy II, 3
- 471 Evolution 1, 3
- 473 History of Biology 1, 3
- 476 Human Genetics II, 3
- 477 Human Genetics 1, 3
- 482 Systematic Entomology II, 3
- 484 (or ELE 484) Modeling of Physiological Systems II, 3

new 543 Biology of Reproduction in Animals 1, 3
Aspects of reproduction in animals of different phyla. Hormonal interrelationships, environmental control and adaptive mechanisms. (Lec. 2, Lab. 3) *Prerequisite: ZOO 345 and 545. In alternate years, next offered 1973-74.* Chipman

545 Endocrinology 1, 3
Comparative anatomy, histology, embryology, physiology of the endocrine glands of vertebrates. Lectures, demonstrations, student reports. (Lec. 3) *Prerequisite: ZOO 314 and 315 or equivalent.* Staff

548 Neurophysiology II, 4
Fundamental processes occurring in the nervous systems of invertebrates and vertebrates. Structure and functions of nervous elements with emphasis on integration and coordination of motor mechanisms. (Lec. 3, Lab. 3) *Prerequisite: ZOO 345, MTH 141 or equivalent, and permission of instructor. In alternate years.* Staff

552 Pathology of Endocrine Functions II, 3
The anatomical, physiological, developmental and behavioral changes associated with disorders of hormone production in vertebrates, primarily in mammals. (Lec. 3) *Prerequisite: ZOO 545 or permission of instructor.* Staff

554 Seminar in Morphogenetic Theory II, 2
Recent investigations in developmental physiology, and the control of differentiation and development. Reference to original papers. (Lec. 2) *Prerequisite: ZOO 315 or equivalent, and permission of instructor. In alternate years, next offered 1973-74.* Goertemiller

5 13 512 Fine Structure II, 4
Experimental evidence correlating the fine structure and function of cell organelles, including especially the plasma membrane, endoplasmic reticulum, mitochondria, ribosomes, centrioles, lysosomes and cilia. Introduction to instrumental and to cytochemical methods for study of each cell. Emphasis on the ex-

562 Seminar in Behavioral Ecology 1, 1
Special topics in the relationships between animal be-

havior and ecology, such as social organization of animals, evolution of behavior, competition and habitat selection. Discussion and presentation of individual reports. (Lec. 1) Staff

563 Ichthyology 1, 3

Fishes of the world. Their structure, evolution, classification, ecology and physiology. Emphasis on local marine and freshwater fauna. Several field trips. (Lec. 2, Lab. 3) Prerequisite: ZOO 200. Krueger

564 Oceanic Ichthyology II, 3

Fishes of the great ocean basins. Their systematics, adaptations, vertical distribution and zoogeography. Emphasis on mesopelagic and bathypelagic forms in the North Atlantic. (Lec. 2, Lab. 3) Prerequisite: ZOO 563 or permission of instructor. In alternate years. Krueger

566 Herpetology II, 3

Biology of recent orders of amphibians and reptiles with emphasis on adaptations and evolution, world faunal relationships past and present, and current systematic problems. Laboratory study of selected herpetological material, field trips, and two week-end trips to the American Museum of Natural History. (Lec. 2, Lab. 3) Prerequisite: ZOO 200 or permission of instructor. Dowling and Shoop

573 Developmental Genetics I, 3

Genetic control of gametogenesis and fertilization. Survey of modern approaches to the problem of gene regulation during embryogenesis with animal systems. (Lec. 3) Prerequisite: ASC 352 or equivalent and permission of instructor. In alternate years. Surver

576 Ecological Genetics II, 4

Analysis of the interactions between genotype and environment in natural and laboratory populations of animals, including selection and other mechanisms responsible for gene frequency change, the evolution of dominance, heterosis and speciation. (Lec. 3, Lab. 3) Prerequisite: BOT 352 or permission of department. Costantino

579 (or BOT 579) Advanced Genetics Seminar I and II, 1

Current topics in genetics, including cytological, ecological, molecular, physiological, population, quantitative and radiation genetics. (Lec. 1) Prerequisite: BOT 352 or ASC 352 and permission of instructor. Costantino and Mottinger

581 General Acarology I, 3

Detailed study of mites and ticks, their structure, life histories, and classification. Free-living forms as well as plant and animal feeders. (Lab. 6) Prerequisite: ZOO 331 or 481 or 586, and permission of instructor. In alternate years. Hyland

586 Medical and Veterinary Entomology II, 3

Life histories, classifications, habits and control of insects and other arthropods which affect the health of man and animals. Duties of the entomologist on pub-

lic health team, including field practice in methods of insect surveys, control measures and subsequent surveys to determine success of control measures. (Lec. 1, Lab. 4) Prerequisite: ZOO 331 or 381 or equivalent. In alternate years, next offered 1973-74. Hyland

595, 596 Graduate Seminar in Zoology I and II, 1 each

Consideration of philosophy and techniques of research and information presentation at the graduate level consisting of reports by students, critique and discussion by the class. Required of entering graduate students in zoology. Prerequisite: graduate standing. S/U credit. Chipman

599 Masters Thesis Research I and II

Number of credits is determined each semester in consultation with the major professor or program committee.

640 to 645 Seminar in Physiology I and II, 1-3 each

Reports and discussions on topics of current research in physiology. Subject matter adapted to meet interests of staff and students. (Lec. 1-3) Prerequisite: ZOO 345. Harrison and Hill

648, 649 Seminar in Environmental Physiology I and II, 2 each

Reading, library research, special lectures on topics of current research interest in environmental physiology. (Lec. 2) Prerequisite: one year of physiology, and at least one course in ecology or permission of department. Staff

664 Seminar in Ichthyology II, 2

Reading, library research, reports and class discussion on problems of current research interest in the biology of fishes. (Lec. 2) Prerequisite: ZOO 563 or permission of department. Krueger

666 Physiological Ecology II, 3

Comparative study of physiological adjustments which animals make in response to environmental factors, with emphasis on the physiological basis of animal distribution and evolution. (Lec. 3) Prerequisite: one year of physiology and a course in ecology. Staff

668 Laboratory in Physiological Ecology II, 3

Application of laboratory techniques to research problems in physiological ecology, such as energetics, gas exchange, thermoregulation and temperature tolerance, salt and water balance, and acclimatization to various environmental factors. Assigned research project on advanced level. (Lab. 9) Prerequisite: ZOO 666 (may be taken concurrently with ZOO 666) and permission of department. Staff

670 to 675 Advanced Ecology Seminars F 71

Specialized and advanced areas of ecological research and theory, including zoogeography, pleistocene ecology, population dynamics, energy flow in ecosystems and radiation ecology. Prerequisite: ZOO 463 and permission of department. Shoop and Staff

new 73-74
679 Animal Communication
 See Oceanography 679.

new 73-74
681 Biological Clocks and Orientation
 See Oceanography 681.

3
691, 692 Assigned Work *I and II, 1-3 each*
 Subject matter adapted to meet needs of student. May be arranged with any member of the staff, with the permission of the head of the department. (*Lec. 3 or Lab. 6*) Staff

3
693, 694 Zoological Problems *I and II, 1-3 each*
 Special work to meet needs of individual students who are prepared to undertake special problems. (*Lec. 3 or Lab. 6*) Staff

3
699 Doctoral Dissertation Research *I and II*
 Number of credits is determined each semester in consultation with the major professor or program committee.

Personnel

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Vincent C. Rose, *Associate Dean*

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John J. Fitzgerald, *Business Administration* (1976)
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Allan H. MacLaine, *Arts and Sciences* (1976)
Rachel K. Maguire, *Graduate Student Association* (1974)
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Walter C. Mueller, *Resource Development* (1975)
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Elijah Swift, *Oceanography* (1976)
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One faculty member to be appointed by the Dean.
One student member to be appointed by the Dean.
President, Graduate Student Association, to be elected.

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GRADUATE FACULTY

The date after the title indicates time of first appointment to the University faculty.

PAUL IRVING ABELL, *Professor of Chemistry*, 1951
Ph.D., 1951, University of Wisconsin.

ELIE ABUSHANAB, *Associate Professor of Medicinal Chemistry*, 1970
Ph.D., 1965, University of Wisconsin.

ROY AGELOFF, *Assistant Professor of Management Science*, 1972
M.B.A., 1967, University of Connecticut.

LUKE S. ALBERT, *Professor of Botany*, 1960
Ph.D., 1958, Rutgers—The State University.

LEWIS M. ALEXANDER, *Professor of Geography and Director, Law of the Sea Institute*, 1960
Ph.D., 1949, Clark University.

ANTHONY J. ALLEN, *Assistant Professor of Education*, 1969
Ph.D., 1970, Boston College.

WILLIAM R. ALLEN, *Assistant Professor of Organizational Management and Industrial Relations*, 1973
M.B.A., 1971, University of Florida.

AARON JOHN ALTON, *Professor of Marketing Management*, 1961
M.B.A., 1947, Harvard Business School; Ph.D., 1956, Ohio State University.

E. JAMES ARCHER, *Professor of Psychology*, 1969
Ph.D., 1952, Northwestern University.

CHARLES P. ARMSTRONG, *Assistant Professor of Management Science*, 1971
M.B.A., 1965, University of Illinois; Ph.D., 1973, University of Arizona.

DENNIS J. ARNST, *Assistant Professor of Audiology*, 1973
Ph.D., 1973, Indiana University.

ROBERT C. AUKERMAN, *Professor of Education*, 1954
Ph.D., 1945, University of Michigan.

RICHARD E. BAILEY, *Associate Professor of Speech*, 1967
Ph.D., 1968, Ohio State University.

BERTON E. BALLARD, *Professor of Pharmacy*, 1972
Ph.D., 1961, University of California.

BRIAN K. BARBER, *Assistant Professor of Transportation Planning*, 1973
M.U.P., 1962, University of Washington.

WALTER L. BARKER, *Associate Professor of English*, 1966
Ph.D., 1966, University of Connecticut.

HAROLD BARNETT, *Instructor in Economics*, 1970
B.A., 1965, Miami University (Ohio).

STANLEY M. BARNETT, *Assistant Professor of Chemical Engineering*, 1969
Ph.D., 1963, University of Pennsylvania.

ROBERT ALFRED BARRON, *Assistant Professor of Mathematics*, 1956
M.A., 1955, Fordham University.

LEONARD J. BASS, *Assistant Professor of Computer Science*, 1970
Ph.D., 1970, Purdue University.

MICHAEL S. BASSIS, *Instructor in Sociology*, 1971
M.A., 1968, University of Chicago.

WALTER J. BEAUPRE, *Professor of Speech*, 1968
Ph.D., 1962, Columbia University.

RAYMOND A. BEAUREGARD, *Assistant Professor of Mathematics*, 1968
Ph.D., 1968, University of New Hampshire.

CARL HARRY BECKMAN, *Professor of Plant Pathology-Entomology*, 1963
Ph.D., 1953, University of Wisconsin.

ROBERT G. BELL, *Assistant Professor of Biochemistry*, 1971
Ph.D., 1964, St. Louis University, School of Medicine.

MICHAEL L. BENDER, *Assistant Professor of Oceanography*, 1972
Ph.D., 1970, Columbia University.

EDWARD G. BENSON, *Assistant Professor of French*, 1970
Ph.D., 1971, Brown University.

JAMES G. BERGAN, *Assistant Professor of Food and Nutritional Science and Food and Resource Chemistry*, 1971
Ph.D., 1970, University of Illinois.

DANIEL P. BERGEN, *Associate Professor of Library Science*, 1970
Ph.D., 1970, University of Minnesota.

STANLEY I. BERGER, *Professor of Psychology*, 1963
Ph.D., 1957, University of Kansas.

MARY R. BERK, *Assistant Professor of Psychology*, 1971
Ph.D., 1971, University of Texas at Austin.

ALLAN BERMAN, *Assistant Professor of Psychology*, 1968
Ph.D., 1968, Louisiana State University.

HAROLD D. BIBB, *Assistant Professor of Zoology*, 1972
Ph.D., 1969, University of Iowa.

HENRY B. BILLER, *Associate Professor of Psychology*, 1970
Ph.D., 1967, Duke University.

JOHN R. BIRK, *Assistant Professor of Electrical Engineering*, 1970
Ph.D., 1971, University of Connecticut.

- J. TEMPLE BLACK, *Associate Professor of Industrial Engineering*, 1972
Ph.D., 1969, University of Illinois.
- LORRAINE C. BLOOMQUIST, *Assistant Professor of Physical Education for Women*, 1967
M.S., 1968, University of Rhode Island.
- LEA M. BOHNERT, *Assistant Professor of Library Science*, 1970
M.A., 1947, University of Chicago.
- HOWARD W. BOND, *Professor of Medicinal Chemistry*, 1966
Ph.D., 1941, University of Illinois.
- G. GEOFFREY BOOTH, *Assistant Professor of Finance*, 1970
Ph.D., 1971, University of Michigan.
- LEON FRANCIS BOUVIER, *Associate Professor of Sociology*, 1966
Ph.D., 1971, Brown University.
- BEVERLY HOSBROOK BOWMAN, *Associate Professor of Marketing Management*, 1954
M.S., 1939, Oklahoma State College.
- DONALD BRADBURY, *Professor of Mechanical Engineering and Applied Mechanics*, 1950
S.D., 1950, Harvard University.
- CALVIN H. BRAINARD, *Professor of Finance and Insurance*, 1953
M.B.A., 1948; Ph.D., 1951, New York University.
- CHARLES H. BRANDON, *Assistant Professor of Accounting*, 1973
Ph.D., 1972, University of Georgia.
- MICHAEL H. BRANSON, *Assistant Professor of Industrial Engineering*, 1969
Ph.D., 1969, Arizona State University.
- JOSIAH MORTON BRIGGS, *Associate Professor of History*, 1969
Ph.D., 1962, Columbia University.
- JAMES DONALD BROMLEY, *Associate Extension Professor of Adult Education*, 1954
Ed.D., 1972, Boston University.
- RICHARD O. BROOKS, *Assistant Professor of Law and Social Planning*, 1970
LL.B., 1962, Yale Law School; Ph.D., 1973, Brandeis University.
- BURTON G. BROWN, JR., *Assistant Professor of History in the Division of University Extension*, 1967
Ph.D., 1973, Brown University.
- CHRISTOPHER W. BROWN, *Associate Professor of Chemistry*, 1968
Ph.D., 1967, University of Minnesota.
- GEORGE A. BROWN, *Professor of Mechanical Engineering and Applied Mechanics, and Ocean Engineering*, 1966
Sc.D., 1960, Massachusetts Institute of Technology.
- JAMES HENRY BROWN, JR., *Associate Professor of Forest and Wildlife Management*, 1958
D.F., 1965, Duke University.
- ANTHONY T. BRYAN, *Assistant Professor of History*, 1969
Ph.D., 1969, University of Nebraska.
- FRANK S. BUDNICK, *Assistant Professor of Management Science*, 1971
D.B.A., 1973, University of Maryland.
- MARGUERITE BUMPUS, *Assistant Professor of Education*, 1969
Ed.D., 1969, University of Massachusetts.
- J. ALLAN CAIN, *Professor of Geology*, 1966
Ph.D., 1962, Northwestern University.
- LEILA SCELONGE CAIN, *Associate Professor of Psychology*, 1966
Ph.D., 1964, Western Reserve University.
- HILDA A. CALABRO, *Assistant Professor of Education*, 1967
Ph.D., 1965, Boston College.
- MARJORIE J. CALDWELL, *Assistant Professor of Food and Nutritional Science*, 1972
Ph.D., 1972, Cornell University.
- RODERICK P. C. CALDWELL, *Assistant Professor of Mathematics*, 1962
Ph.D., 1962, University of Illinois.
- FRANCIS X. CAMERON, *Visiting Instructor, Master of Marine Affairs Program*, 1972
J.D., 1971, University of Pittsburgh; M.M.A., 1972, University of Rhode Island.
- DAVID S. CAMP, *Associate Professor of Psychology, and Director, General-Experimental Program*, 1964
Ph.D., 1965, Brown University.
- HENRY CAMPBELL, *Professor of Civil and Environmental Engineering*, 1946
S.M., 1940, Harvard Graduate School of Engineering.
- NORMAN A. CAMPBELL, *Associate Professor of Pharmacy Administration*, 1970
J.D., 1968, New England School of Law; Ph.D., 1972, University of Wisconsin-Madison.
- WALTER CANE, *Assistant Professor of English in the Division of University Extension*, 1967
Ph.D., 1966, Vanderbilt University.
- RUSSELL B. CAPELLE, JR., *Assistant Professor of Geography*, 1971
Ph.D., 1973, University of Pittsburgh.
- GARY P. CARLSON, *Assistant Professor of Pharmacology*, 1969
Ph.D., 1969, University of Chicago.
- EDWARD J. CARNEY, *Associate Professor of Computer Science and Statistics*, 1967
Ph.D., 1967, Iowa State University.

- NESTOR EDGAR CAROSELLI, *Professor of Botany, 1954*
Ph.D., 1954, Brown University.
- PHILIP LEWIS CARPENTER, *Professor of Microbiology, 1942*
Ph.D., 1937, University of Wisconsin.
- VIRGINIA V. CARPENTER, *Professor of Textiles and Clothing, 1949*
Ph.D., 1963, Iowa State University.
- FRANK M. CARRANO, *Assistant Professor of Computer Science, 1969*
Ph.D., 1969, Syracuse University.
- LEO CARROLL, *Instructor in Sociology, 1972*
M.A., 1964, Fordham University.
- JAMES EDWARD CASEY, *Professor of Education, 1947*
Ed.D., 1952, Harvard University.
- PEI WEN CHANG, *Professor of Animal Pathology, 1955*
Ph.D., 1965, Yale University.
- ARMAND B. CHARTIER, *Assistant Professor of French, 1971*
Ph.D., 1970, University of Massachusetts, Amherst.
- CLAIR J. CHEER, *Assistant Professor of Chemistry, 1968*
Ph.D., 1964, Wayne State University.
- CLINTON O. CHICHESTER, *Professor of Food and Resource Chemistry, 1970*
Ph.D., 1954, University of California.
- FRANCES WANG CHIN, *Associate Professor of Library Science, 1965*
Ph.D., 1941, University of Michigan; M.S.L.S., 1962, University of Kentucky.
- ROBERT KENNETH CHIPMAN, *Professor of Zoology, 1968*
Ph.D., 1963, Tulane University.
- AMAR CHOUDRY, *Assistant Professor of Physics, 1967*
Ph.D., 1967, Columbia University.
- PAUL FRANCIS CIEURZO, *Professor of Health and Physical Education for Men, 1936*
M.A., 1939, Columbia University.
- NORMAN COATES, *Professor of Organizational Management and Industrial Relations, 1971*
Ph.D., 1967, Cornell University.
- J. STANLEY COBB, *Assistant Professor of Zoology, 1970*
Ph.D., 1969, University of Rhode Island.
- JOEL A. COHEN, *Associate Professor of History, 1965*
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- PAUL SIDNEY COHEN, *Associate Professor of Microbiology, 1966*
Ph.D., 1964, Boston University.
- STEWART COHEN, *Associate Professor of Child Development and Family Relations, 1972*
Ph.D., 1967, Purdue University.
- BILLY GENE COLLINS, *Assistant Professor of English, 1970*
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- SPIROS M. CONSTANTINIDES, *Associate Professor of Food and Nutritional Science and Biochemistry, 1968*
Ph.D., 1966, Michigan State University.
- LEWIS D. CONTA, *Dean of the College of Engineering and Professor of Mechanical Engineering, 1969*
Ph.D., 1942, Cornell University.
- CONSTANCE E. COOPER, *Assistant Professor of Home Economics Education and Child Development and Family Relations, 1973*
M.S., 1950, Cornell University.
- JAMES W. COOPER, JR., *Assistant Professor of Pharmacy and Coordinator of Clinical Pharmacy, 1972*
B.S., 1968, University of Georgia.
- CLIFFORD JAMES COSGROVE, *Associate Professor of Animal Science, 1953*
M.S., 1957, University of Rhode Island.
- ROBERT F. COSTANTINO, *Associate Professor of Zoology, 1972*
Ph.D., 1967, Purdue University.
- FRANK COSTIGLIOLA, *Assistant Professor of History, 1972*
Ph.D., 1973, Cornell University.
- ELIZABETH WALBERT CRANDALL, *Professor of Home Management, 1946*
Ed.D., 1962, Boston University.
- RAWLAND G. CRESSER, *Director of Audiovisual Center and Assistant Professor of Education, 1968*
D.Ed., 1968, Boston University.
- WILLIAM CROASDALE, *Associate Professor of Education, 1965*
Ed.D., 1966, Teachers College, Columbia University.
- DAVID H. CROMBE, *Assistant Dean of the College of Pharmacy and Associate Professor of Pharmacy Administration, 1966*
M.S., 1935, University of Southern California.
- JEANETTE E. CROOKER, *Associate Professor of Physical Education for Women, 1955*
M.S., 1959, University of Rhode Island.
- RUTH G. CUMINGS, *Professor of Community Mental Health Nursing, 1970*
R.N., 1935, Jewish Hospital Training School for Nurses; Ed.D., 1964, Teachers College, Columbia University.
- RONALD G. CUMMINGS, *Professor of Resource Economics, 1972*
Ph.D., 1968, University of Kansas.
- FRANK WILLIAM CUOMO, *Assistant Professor of Physics, 1959*
M.S., 1961, University of Rhode Island.

- BEVERLY DOWNING CUSACK, *Dean of the College of Home Economics and Professor of Home Economics*, 1948
Ed.D., 1962, Teachers College, Columbia University.
- JOEL A. DAIN, *Associate Professor of Biochemistry*, 1962
Ph.D., 1957, Cornell University.
- JAMES CAFFREY DALY, *Assistant Professor of Electrical Engineering*, 1969
Ph.D., 1967, Rensselaer Polytechnic Institute.
- CHARLES E. DANIEL, JR., *Assistant Professor of History*, 1967
Ph.D., 1968, Ohio State University.
- DILIP K. DATTA, *Associate Professor of Mathematics*, 1967
Ph.D., 1963, Delhi University.
- DAVID ROCKWELL DEFANTI, *Professor of Pharmacology*, 1961
Ph.D., 1962, University of Rhode Island.
- JOHN JOSEPH DEFEO, *Professor of Pharmacology*, 1957
Ph.D., 1954, Purdue University.
- ALBERT J. DELLA BITTA, *Assistant Professor of Marketing Management*, 1971
M.B.A., 1966; Ph.D., 1971, University of Massachusetts.
- GEORGE DE LODZIA, *Associate Professor of Organizational Management and Industrial Relations*, 1970
Ph.D., 1969, Syracuse University.
- FRANK DELSANTO, *Assistant Professor of Physical Education for Men, and Director of Basic Physical Education for Men*, 1965
Ed.M., 1957, Boston University.
- FRANK DELUISE, *Associate Professor of Mechanical Engineering and Applied Mechanics*, 1950
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- LOUIS R. DESFOSSÉS, *Assistant Professor of Organizational Management and Industrial Relations*, 1970
M.B.A., 1964, Boston College; Ph.D., 1971, University of Massachusetts.
- JOHN SCOTT DESJARDINS, *Associate Professor of Physics*, 1960
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- FRANK TOBIAS DIETZ, *Professor of Physics and Oceanography*, 1954
Ph.D., 1951, Pennsylvania State University.
- GEORGE J. DILLAVOU, *Dean of the Division of University Extension and Professor of Speech and Education*, 1971
Ph.D., 1970, University of Chicago.
- JOEL B. DIRLAM, *Professor of Economics and Resource Economics*, 1964
Ph.D., 1947, Yale University.
- GERALD A. DONOVAN, *Dean of the College of Resource Development, Director of the Agricultural Experiment Station, Director of the Cooperative Extension Service, and Professor of Animal Science*, 1973
Ph.D., 1955, Iowa State University.
- AGNES G. DOODY (MRS. ARTHUR D. JEFFREY), *Professor of Speech*, 1958
Ph.D., 1961, Pennsylvania State University.
- RODGER B. DOWDELL, *Professor of Mechanical Engineering and Applied Mechanics*, 1966
Ph.D., 1966, Colorado State University.
- CHARLES E. DOWNE, *Associate Professor of Community Planning*, 1968
C.E., 1938, Yale School of Engineering.
- RODNEY D. DRIVER, *Associate Professor of Mathematics*, 1969
Ph.D., 1960, University of Minnesota.
- DONALD A. DUBOIS, *Assistant Professor of Accounting*, 1973
M.B.A., 1963, Wharton School, University of Pennsylvania.
- ROBERT A. DUCE, *Professor of Oceanography*, 1970
Ph.D., 1964, Massachusetts Institute of Technology.
- DALE THOMAS DUFF, *Assistant Professor of Plant and Soil Science*, 1967
Ph.D., 1967, Michigan State University.
- WAYNE KING DURFEE, *Associate Professor of Animal Science*, 1951
Ph.D., 1963, Rutgers—The State University.
- WILFRED P. DVORAK, *Assistant Professor of English in the Division of University Extension*, 1968
Ph.D., 1972, Indiana University.
- HENRY A. DYMSZA, *Professor of Food and Nutritional Science*, 1966
Ph.D., 1954, Pennsylvania State University.
- RALPH W. ENGLAND, JR., *Professor of Sociology*, 1960
Ph.D., 1954, University of Pennsylvania.
- HELLMUTH ETZOLD, *Associate Professor of Electrical Engineering*, 1963
Dr. rer. nat., 1933, University of Freiburg.
- PEN JENG FANG, *Assistant Professor of Civil and Environmental Engineering*, 1970
Ph.D., 1966, Cornell University.
- JAMES L. FASCHING, *Assistant Professor of Chemistry*, 1969
Ph.D., 1970, Massachusetts Institute of Technology.

- DAMIAN P. FEDORYKA, *Assistant Professor of Philosophy*, 1970
Ph.D., 1970, Universitat Salzburg.
- GEORGE T. FELBECK, JR., *Professor of Food and Resource Chemistry*, 1964
Ph.D., 1957, Pennsylvania State University.
- WILLIAM ROBERT FERRANTE, *Acting President and Professor of Mechanical Engineering and Applied Mechanics*, 1956
Ph.D., 1962, Virginia Polytechnic Institute.
- GORDON FIELD, *Assistant Professor of Plant Pathology-Entomology*, 1968
Ph.D., 1957, University of Massachusetts.
- JAMES F. FINDLAY, JR., *Professor of History*, 1971
Ph.D., 1961, Northwestern University.
- NORMAN J. FINIZIO, *Assistant Professor of Mathematics*, 1963
Ph.D., 1972, Courant Institute of Mathematical Sciences, New York University.
- HAROLD W. FISHER, *Professor of Biophysics*, 1963
Ph.D., 1959, University of Colorado.
- JOHN J. FISHER, *Assistant Professor of Geology*, 1964
Ph.D., 1967, University of North Carolina.
- GEORGE THORNTON FITZELLE, *Professor of Child Development and Family Relations*, 1959
Ph.D., 1952, Cornell University.
- JOHN F. FITZGERALD, JR., *Assistant Professor of Finance and Insurance*, 1971
M.B.A., 1964, Northeastern University; Ph.D., 1971, University of Wisconsin; C.L.U., C.P.C.U.
- RUTH M. FITZSIMONS, *Professor of Speech*, 1969
D.Ed., 1955, Boston University.
- HOWARD H. FOSTER, JR., *Associate Professor of Community Planning*, 1963
M.C.P., 1963, Yale University; Ph.D., 1970, Cornell University.
- JOHN BLACKMON FRALEIGH, *Associate Professor of Mathematics*, 1962
M.A., 1956, Princeton University.
- SPENCER FREEDMAN, *Assistant Professor of Spanish*, 1968
Ph.D., 1972, University of Massachusetts.
- DAVID HUGH FREEMAN, *Professor of Philosophy*, 1957
Ph.D., 1958, University of Pennsylvania.
- REINHARD K. FROHLICH, *Assistant Professor of Geology*, 1973
Ph.D., 1966, University Clausthal-Zellerfeld.
- MARION LOUISE FRY, *Associate Professor of Textiles and Clothing*, 1947
M.A., 1947, Teachers College, Columbia University.
- GEORGE C. FULLER, *Associate Professor of Pharmacology*, 1966
Ph.D., 1967, Purdue University.
- JOHN K. GAMBLE, *Associate Director of the Law of the Sea Institute and Assistant Professor of Marine Affairs*, 1971
Ph.D., 1970, University of Washington.
- ROBERT V. GARDNER, *Associate Professor of Sociology*, 1949
Ph.D., 1959, University of Illinois.
- JOHN M. GATES, *Assistant Professor of Resource Economics*, 1969
Ph.D., 1969, University of California.
- DAVID GLASSNER GEFFNER, *Professor of Business Law*, 1937
J.D., 1930, Boston University.
- CARL GERSUNY, *Associate Professor of Sociology*, 1968
Ph.D., 1968, Western Reserve University.
- PETER J. GIELISSE, *Professor of Materials and Chemical Engineering*, 1968
Ph.D., 1961, Ohio State University.
- MARY JAMES GILBERT, *Assistant Professor of Textiles and Clothing*, 1959
M.S., 1960, University of Rhode Island.
- CLARENCE CHRISTIAN GOERTEMILLER, JR., *Associate Professor of Zoology*, 1965
Ph.D., 1964, Brown University.
- ROBERT H. GOFF, *Associate Professor of Mechanical Engineering and Applied Mechanics*, 1958
M.S., 1956, Cornell University.
- RICHARD DONALD GONZALEZ, *Associate Professor of Chemistry*, 1965
Ph.D., 1965, The Johns Hopkins University.
- LEON GOODMAN, *Professor of Chemistry*, 1970
Ph.D., 1950, University of California at Los Angeles.
- ROGER D. GOOS, *Professor of Botany*, 1970
Ph.D., 1958, University of Iowa.
- WALTER PHILLIP GOULD, *Associate Professor of Forest and Wildlife Management*, 1954
Ph.D., 1966, Syracuse University.
- H. GLENN GRAY, *Assistant Professor of Animal Science*, 1969
Ph.D., 1966, Cornell University.
- LAWRENCE C. GREBSTEIN, *Associate Professor of Psychology*, 1964
Ph.D., 1964, University of Kentucky.
- HELEN FINCH GREENE, *Assistant Professor of Child Development and Family Relations*, 1971
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Ph.D., 1968, State University of New York, Stony Brook.
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Ph.D., 1971, Syracuse University.
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M.B.A., 1960, Northeastern University; C.P.A.; J.D., 1971, Suffolk University.
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Ph.D., 1958, University of Colorado.
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Ph.D., 1953, University of California at Los Angeles.
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M.S., 1969, Ohio State University.
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M.S., 1946, University of Minnesota.
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Ph.D., 1947, University of Illinois.
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Ph.D., 1951, Brown University.
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Ph.D., 1966, University of Texas.
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- R. B. REAVES, JR., *Assistant Professor of English*, 1968
Ph.D., 1971, University of Wisconsin.
- STANLEY MARVIN RIFE, *Professor of Education*, 1955
Ph.D., 1951, University of Chicago.
- ERWIN ARTHUR ROBINSON, *Professor of English*, 1946
Ph.D., 1936, Ohio State University.
- THOMAS J. ROCKETT, *Associate Professor of Materials and Chemical Engineering*, 1971
Ph.D., 1963, Ohio State University.
- NIELS RORHOLM, *Coordinator of Sea Grant Programs and Professor of Resource Economics*, 1954
Ph.D., 1954, University of Minnesota.
- VINCENT C. ROSE, *Associate Dean of the Graduate School and Associate Professor of Nuclear and Ocean Engineering*, 1963
Ph.D., 1964, University of Missouri.
- WILLIAM M. ROSEN, *Assistant Professor of Chemistry*, 1970
Ph.D., 1967, University of California at Riverside.
- WILLIAM R. ROSENGREN, *Professor of Sociology*, 1967
M.A., 1963, Brown University.
- DOUGLAS McDONALD ROSIE, *Assistant Dean of the College of Arts and Sciences and Professor of Chemistry*, 1958
Ph.D., 1955, Cornell University.

- H. DOROTHY ROTHSCHILD, *Associate Professor of French*, 1962
Ph.D., 1959, Columbia University.
- RICHARD ALLEN ROUGHTON, *Assistant Professor of History*, 1968
Ph.D., 1971, University of Maryland.
- EMILIO O. ROXIN, *Professor of Mathematics*, 1967
Ph.D., 1959, University of Buenos Aires.
- STANLEY RUBINSKY, *Associate Professor of Industrial Engineering*, 1954
M.M.E., 1950, University of Delaware.
- FRANCIS XAVIER RUSSO, *Associate Dean of the College of Arts and Sciences and Professor of Education*, 1966
Ph.D., 1964, Boston University.
- RICHARD ALBERT SABATINO, *Professor of Economics*, 1952
Ph.D., 1950, University of Pennsylvania.
- ANGARAIH GANESAN SADASIV, *Associate Professor of Electrical Engineering*, 1969
Ph.D., 1963, Purdue University.
- SAUL BERNHARD SAILA, *Professor of Oceanography and Zoology*, 1956
Ph.D., 1952, Cornell University.
- MILTON SALOMON, *Professor of Food and Resource Chemistry*, 1939
Ph.D., 1952, North Carolina State College.
- LUCY V. SALVATORE, *Assistant Professor of Library Science*, 1964
M.S.L.S., 1958, University of Illinois.
- BROOKS AYMOR SANDERSON, *Professor of Accounting*, 1942
M.B.A., 1936, Harvard Graduate School of Business Administration; Ed.D., 1959, Boston University.
- ARUN P. SANGHVI, *Assistant Professor of Management Science*, 1973
M.S., 1967, University of Massachusetts; M.S., 1968, Case Institute of Technology.
- AKELLA N. SASTRY, *Associate Professor of Oceanography*, 1966
Ph.D., 1961, Florida State University.
- JEROME A. SCHAFFRAN, *Assistant Professor of Education*, 1971
Ph.D., 1971, The University of Iowa.
- HILBERT VAN N. SCHENCK, JR., *Professor of Mechanical Engineering and Applied Mechanics and Ocean Engineering*, 1967
M.S., 1952, Stanford University.
- JEAN-GUY SCHILLING, *Associate Professor of Oceanography*, 1966
Ph.D., 1966, Massachusetts Institute of Technology.
- CHARLES T. SCHMIDT, JR., *Associate Professor of Organizational Management and Industrial Relations*, 1968
M.B.A., 1962, Northeastern University; M.I.L.R., 1964, Cornell University; Ph.D., 1968, Michigan State University.
- STEWART P. SCHNEIDER, *Assistant Professor of Library Science*, 1964
M.S., 1964, School of Library Service, Columbia University.
- ERIC THOMAS SCHOONOVER, *Assistant Professor of English*, 1962
A.M., 1959, University of Michigan.
- BERNARD SCHURMAN, *Professor of Economics*, 1948
Ph.D., 1958, Columbia University.
- SOL SCHWARTZMAN, *Associate Professor of Mathematics*, 1969
Ph.D., 1953, Yale University.
- STEPHEN D. SCHWARZ, *Associate Professor of Philosophy*, 1963
Ph.D., 1966, Harvard University.
- EDMOND E. SEAY, JR., *Assistant Professor of Resource Economics*, 1970
Ph.D., 1970, Iowa State University.
- JULES P. SEIGEL, *Associate Professor of English*, 1965
Ph.D., 1965, University of Maryland.
- ROGER S. SENNOTT, *Assistant Professor of Sociology*, 1971
Ph.D., 1971, University of Pennsylvania.
- DAVID M. SHAO, *Assistant Professor of Industrial Engineering*, 1969
Ph.D., 1970, State University of New York at Buffalo.
- GAROLD SHARPE, *Associate Professor of English*, 1950
M.A., 1948, Columbia University.
- HERMAN E. SHEETS, *Professor of Ocean Engineering*, 1969
Doctor of Tech. Sci., 1936, Technical University, Prague, Czechoslovakia.
- RANDOLPH F. C. SHEN, *Associate Professor of Management Science*, 1966
Ph.D., 1964, University of Illinois.
- ARTHUR LEO SHERMAN, *Assistant Professor of Physical Education for Men*, 1959
M.Ed., 1964, Boston University.
- GEORGE DAVID SHILLING, *Professor of Chemical Engineering*, 1952
Ph.D., 1950, University of Wisconsin.
- YUZURU SHIMIZU, *Associate Professor of Pharmacology*, 1969
Ph.D., 1963, Hokkaido University.
- DOUGLAS W. SHIVVERS, *Assistant Professor of Microbiology*, 1972
Ph.D., 1971, Iowa State University.

- C. ROBERT SHOOP, *Associate Professor of Zoology*, 1969
Ph.D., 1963, Tulane University.
- VLADAMIR GREGORY SHUTAK, *Professor of Plant and Soil Science*, 1946
Ph.D., 1942, University of Maryland.
- JOHN MCNEILL SIEBURTH, *Professor of Oceanography and Microbiology*, 1960
Ph.D., 1954, University of Minnesota.
- ALBERT SILVERSTEIN, *Associate Professor of Psychology*, 1963
Ph.D., 1963, University of California.
- GINO SILVESTRI, *Assistant Professor of History*, 1965
Ph.D., 1969, Syracuse University.
- KENNETH L. SIMPSON, *Professor of Food and Resource Chemistry*, 1964
Ph.D., 1963, University of California.
- ROBERT C. SINE, *Associate Professor of Mathematics*, 1971
Ph.D., 1962, University of Illinois.
- CLAY V. SINK, *Assistant Professor of Business Education and Office Administration*, 1969
Ph.D., 1968, Ohio State University.
- CONRAD RICHARD SKOGLEY, *Professor of Plant and Soil Science, and Secretary of the University Faculty*, 1960
Ph.D., 1957, Rutgers—The State University.
- CARL VINCENT SLADER, *Professor of Health and Physical Education for Men*, 1952
M.Ed., 1937, Boston University.
- RUSSELL COOK SMART, *Professor of Child Development and Family Relations*, 1953
Ph.D., 1938, University of Minnesota.
- THEODORE JOHN SMAYDA, *Professor of Oceanography and Botany*, 1959
Dr. philos., 1967, University of Oslo.
- CHARLES IRVEL SMITH, *Associate Professor of Medicinal Chemistry*, 1960
Ph.D., 1950, University of Maryland.
- EPHRAIM P. SMITH, *Associate Professor of Accounting*, 1968
Ph.D., 1968, University of Illinois.
- KATHLEEN F. SMITH, *Associate Professor of Business Education and Office Administration*, 1955
Ed.D., 1973, Boston University.
- LEWIS TURNER SMITH, *Station Statistician and Professor of Animal Science and Statistics*, 1964
Ph.D., 1962, Iowa State University.
- NELSON F. SMITH, *Associate Professor of Psychology*, 1965
Ph.D., 1963, Princeton University.
- WARREN DALE SMITH, *Professor of English*, 1942
Ph.D., 1948, University of Pennsylvania.
- LANNY O. SODERBERG, *Associate Professor of Education*, 1967
Ph.D., 1967, University of Iowa.
- ROBERT J. SONSTROEM, *Assistant Professor, Director of Research in Health and Physical Education for Men*, 1969
Ph.D., 1968, University of Minnesota.
- ROBERT PARKER SORLIEN, *Professor of English*, 1946
Ph.D., 1955, Brown University.
- IRVING A. SPAULDING, *Professor of Resource Economics and Rural Sociology*, 1949
Ph.D., 1944, Cornell University.
- DAVID SPEICHER, SR., *Assistant Professor of Finance*, 1971
M.S., 1969, State University of New York at Binghamton.
- DONALD SPENCE, *Coordinator of Gerontology and Associate Professor of Child Development and Family Relations*, 1973
Ph.D., 1965, University of Oregon.
- JOHN E. SPENCE, *Associate Professor of Electrical Engineering*, 1962
Ph.D., 1962, University of Wisconsin.
- JAMES L. STARKEY, *Assistant Professor of Economics*, 1967
Ph.D., 1971, Boston College.
- EDNA L. STEEVES, *Associate Professor of English in the Division of University Extension*, 1967
Ph.D., 1948, Columbia University.
- ARTHUR STEIN, *Associate Professor of Political Science*, 1965
Ph.D., 1965, University of Pennsylvania.
- MELVIN ERNEST STERN, *Professor of Oceanography*, 1964
Ph.D., 1956, Massachusetts Institute of Technology.
- HAROLD STERNBACH, *Associate Professor of Management Science and Coordinator of Business Studies in the Division of University Extension*, 1947
M.S., 1947, Columbia University.
- SHARON H. CARROLL STROM, *Assistant Professor of History*, 1969
Ph.D., 1969, Cornell University.
- IRENE HAWKINS STUCKEY, *Professor of Plant Physiology*, 1937
Ph.D., 1936, Cornell University.
- RICHARD E. SULLIVAN, *Assistant Professor of Education*, 1971
Ph.D., 1971, University of Texas at Austin.
- WILLIAM M. SURVER, *Instructor in Zoology*, 1972
B.S., 1966, St. Francis College, Pennsylvania.
- E. RAMNATH SURYANARAYAN, *Professor of Mathematics*, 1960
Ph.D., 1961, University of Michigan.

- DONALD L. SUSSMAN, *Assistant Professor of Civil Engineering, 1967*
Ph.D., 1966, Polytechnic Institute of Brooklyn.
- GILBERT SUZAWA, *Instructor in Economics, 1971*
M.A., 1967, University of Hawaii.
- ELIJAH SWIFT V, *Assistant Professor of Oceanography, 1969*
Ph.D., 1967, The Johns Hopkins University.
- ALVIN K. SWONGER, *Assistant Professor of Pharmacology and Toxicology, 1971*
Ph.D., 1971, Dartmouth College.
- BARBARA L. TATE, *Dean of the College of Nursing and Professor of Nursing, 1969*
Diploma, 1942, Mountinside Hospital School of Nursing; Ed.D., 1961, Teachers College, Columbia University.
- FREDERICK LAURENT TEST, *Professor of Mechanical Engineering and Applied Mechanics, 1949*
Ph.D., 1956, Pennsylvania State University.
- DAVID E. TETREALT, *Assistant Professor of Computer Science, 1967*
M.S., 1972, University of Rhode Island.
- DANIEL HARRISON THOMAS, *Professor of History, 1940*
Ph.D., 1934, University of Pennsylvania.
- A. RALPH THOMPSON, *Director of the Rhode Island Water Resources Center and Professor of Chemical Engineering, 1952*
Ph.D., 1945, University of Pennsylvania.
- GARY THURSTON, *Assistant Professor of History, 1966*
Ph.D., 1973, Columbia University.
- DAVID K. TITUS, *Instructor in English, 1970*
M.A., 1967, State University of New York at Albany.
- CONSTANTIN TOLOUDIS, *Assistant Professor of French, 1966*
Ph.D., 1969, Rice University.
- TOM H. TOWERS, *Assistant Professor of English in the Division of University Extension, 1971*
Ph.D., 1971, Tulane University.
- RICHARD VITO TRAVISANO, *Assistant Professor of Sociology, 1969*
Ph.D., 1973, University of Minnesota.
- RICHARD W. TRAXLER, *Professor of Plant Pathology-Entomology and Microbiology, 1971*
Ph.D., 1958, University of Texas.
- GEORGE C. TREMBLAY, *Associate Professor of Biochemistry, 1966*
Ph.D., 1965, St. Louis University.
- ROBERT E. TREYBAL, *Professor of Chemical Engineering, 1973*
Ph.D., 1942, Columbia University.
- JONATHAN STEDMAN TRYON, *Assistant Professor of Library Science, 1969*
M.S., 1963, Columbia University; M.A., 1970, University of Rhode Island.
- DONALD W. TUFTS, *Professor of Electrical Engineering, 1967*
Sc.D., 1960, Massachusetts Institute of Technology.
- JOSEPH GEORGE TURCOTTE, *Associate Professor of Medicinal Chemistry, 1967*
Ph.D., 1967, University of Minnesota.
- RALPH M. TUTT, *Associate Professor of English, 1964*
Ph.D., 1966, Duke University.
- GERRY RUTH SACK TYLER, *Assistant Professor of Political Science, 1966*
Ph.D., 1972, Yale University.
- EUGENE J. TYNAN, *Associate Professor of Geology, 1959*
Ph.D., 1962, University of Oklahoma.
- RICHARD VANGERMEERSCH, *Associate Professor of Accounting, 1971*
Ph.D., 1970, University of Florida; C.P.A.
- ANDREW VELLETRI, *Associate Professor of Mechanical Engineering, 1951*
M.S., 1957, University of Connecticut.
- GHASI RAM VERMA, *Associate Professor of Mathematics, 1964*
Ph.D., 1957, Rajasthan University.
- BRUNO M. VITTIMBERGA, *Professor of Chemistry, 1961*
Ph.D., 1957, University of Illinois.
- THOMAS E. VOLLMANN, *Professor of Management Science, 1971*
M.B.A., 1962; Ph.D., 1964, University of California, Los Angeles.
- WILLIAM THOMAS VOSBURGH, *Professor of Psychology and Director, School Psychology Program, 1965*
Ph.D., 1965, Syracuse University.
- FERDINAND VOTTA, JR., *Associate Professor of Chemical Engineering, 1946*
D.Eng., 1958, Yale University.
- ROBERT C. WAKEFIELD, *Professor of Plant and Soil Science, 1954*
Ph.D., 1954, Rutgers—The State University.
- WILLIAM HENRY WALLACE, *Associate Extension Professor of Resource Economics, 1953*
M.S., 1951, University of New Hampshire.
- MIAN-CHANG WANG, *Assistant Professor of Civil Engineering, 1968*
Ph.D., 1968, University of California at Berkeley.
- DAVID DANIEL WARREN, *Professor of Political Science, 1953*
Ph.D., 1959, Fletcher School of Law and Diplomacy.

- HAROLD ARTHUR WATERS, *Professor of French*, 1962
Ph.D., 1956, University of Washington.
- NORMAN D. WATKINS, *Professor of Oceanography*, 1970
Ph.D., 1964, University of London.
- THOMAS F. WEAVER, *Assistant Professor of Resource Economics*, 1971
Ph.D., 1966, Cornell University.
- PATRICIA JOYCE WEEDEN, *Assistant Professor of Textiles and Clothing*, 1961
M.S., 1961, University of Rhode Island.
- RICHARD R. WEEKS, *Dean of the College of Business Administration and Professor of Marketing Management*, 1970
M.B.A., 1960; D.B.A., 1966, Washington University.
- NELSON H. WEIDERMAN, *Assistant Professor of Computer Science*, 1971
Ph.D., 1971, Cornell University.
- ROBERT G. WEISBORD, *Professor of History*, 1966
Ph.D., 1966, New York University Graduate School.
- FRITZ WENISCH, *Assistant Professor of Philosophy*, 1971
Ph.D., 1968, University of Salzburg.
- CHARLES M. WHITCOMB, *Assistant Professor of Education*, 1969
Ed.D., 1965, Boston University.
- FRANK M. WHITE, JR., *Professor of Mechanical and Ocean Engineering*, 1964
Ph.D., 1959, Georgia Institute of Technology.
- GEORGE H. WILLIS, *Assistant Professor of Education*, 1971
Ph.D., 1971, Johns Hopkins University.
- ALAN WILLOUGHBY, *Associate Professor of Psychology*, 1968
Ph.D., 1959, University of Connecticut.
- MASON P. WILSON, JR., *Associate Professor of Mechanical Engineering and Applied Mechanics*, 1968
Ph.D., 1968, University of Connecticut.
- HOWARD ELLIOT WINN, *Professor of Oceanography and Zoology*, 1965
Ph.D., 1955, University of Michigan.
- RICHARD E. WOLKE, *Assistant Professor of Animal Pathology*, 1970
D.V.M., 1962, Cornell University; Ph.D., 1968, University of Connecticut.
- NORRIS P. WOOD, *Professor of Microbiology and Biophysics*, 1963
Ph.D., 1955, University of Pennsylvania.
- PORTER SHELLEY WOOD, *Associate Professor of Accounting*, 1955
M.A., 1950, University of Kentucky; C.P.A.
- RICHARD DAWSON WOOD, *Professor of Botany*, 1947
Ph.D., 1947, Northwestern University.
- STEPHEN B. WOOD, *Professor of Political Science*, 1967
Ph.D., 1964, University of Chicago.
- FRANK LESLIE WOODS, *Dean of the Summer Session and Professor of German*, 1956
Ph.D., 1951, Yale University.
- LEONARD ROBERT WORTHEN, *Professor of Pharmacognosy*, 1957
Ph.D., 1957, University of Massachusetts.
- VANCE JOSEPH YATES, *Professor of Animal Pathology*, 1949
D.V.M., 1949, Ohio State University; Ph.D., 1960, University of Wisconsin.
- WILLIAM YOUNG, *Associate Professor of Philosophy*, 1960
Th.D., 1944, Union Theological Seminary; B.Litt., 1958, University of Oxford.
- HEBER W. YOUNGKEN, JR., *Provost for Health Science Affairs, Dean of the College of Pharmacy, and Professor of Pharmacognosy*, 1957
Ph.D., 1942, University of Minnesota.
- MAURICE ZARCHEN, *Associate Professor of Physical Education for Men and Director of Athletics*, 1961
M.A., 1950, Columbia University.
- ROBERT L. ZARTLER, *Assistant Professor of Management Science*, 1971
M.B.A., 1968, Dartmouth College.
- DONALD J. ZEYL, *Assistant Professor of Philosophy*, 1971
Ph.D., 1972, Harvard University.
- DONALD J. ZINN, *Professor of Zoology*, 1946
Ph.D., 1942, Yale University.
- NORMAN I. ZUCKER, *Professor of Political Science*, 1966
Ph.D., 1960, Rutgers—The State University.

GRADUATE ADJUNCT FACULTY

- LUCIEN M. BIBERMAN, *Adjunct Professor of Electrical Engineering*, 1972
B.S., 1940, Rensselaer Polytechnic Institute.
- VICTOR J. CABELLI, *Adjunct Professor of Microbiology*, 1965
Ph.D., 1951, University of California at Los Angeles.
- RICHARD J. CODURI, JR., *Adjunct Professor of Animal Science*, 1972
M.S., 1971, University of Rhode Island.
- AHMED H. DARDIRI, *Adjunct Professor of Animal Pathology*, 1968
Ph.D., 1950, Michigan State University.
- JELLE DEBOER, *Adjunct Professor of Oceanography*, 1969
Ph.D., 1963, University of Utrecht.

- A. FRANCIS DIMEGLIO, *Adjunct Professor of Nuclear Engineering, 1965*
B.S., 1952, Providence College.
- FREDERICK R. DINAPOLI, *Adjunct Professor of Ocean Engineering, 1970*
Ph.D., 1969, University of Rhode Island.
- HERNDON G. DOWLING, *Adjunct Professor of Zoology, 1964*
Ph.D., 1951, University of Michigan.
- MICHAEL DOYLE, *Adjunct Professor of Nuclear Engineering, 1965*
B.S., 1958, Scranton University.
- RONALD EISLER, *Adjunct Professor of Oceanography, 1970*
Ph.D., 1961, University of Washington.
- ROBERT H. GIBBS, *Adjunct Professor of Zoology, 1971*
Ph.D., 1955, Cornell University.
- JAMES A. HALL, *Adjunct Professor of Electrical Engineering, 1973*
Ph.D., 1971, University of Rhode Island.
- RUPERT P. HAMMOND, *Adjunct Professor of Biochemistry, 1970*
Ph.D., 1968, Brown University.
- SIDNEY J. HOLT, *Adjunct Professor of Oceanography, 1972*
D.Sc., 1966, University of Reading, Berkshire, England.
- ARTHUR M. KAPLAN, *Adjunct Professor of Plant Pathology-Entomology, 1969*
Ph.D., 1948, University of Massachusetts.
- YANI KARKALAS, *Adjunct Professor of Pharmacology-Toxicology and Psychology, 1969*
M.D., 1953, University of Istanbul, Turkey.
- BENJAMIN KAZAN, *Adjunct Professor of Electrical Engineering, 1969*
Ph.D., 1961, Technische Hochschule, Germany.
- KERN KENYON, *Adjunct Professor of Oceanography, 1973*
Ph.D., 1966, University of California at San Diego.
- DALE CURTISS KRAUSE, *Adjunct Professor of Oceanography, 1962*
Ph.D., 1961, University of California.
- OSCAR CHUM LIU, *Adjunct Professor of Animal Pathology, 1965*
M.D., 1943, Cheeloo University; D.M.Sc., 1952, University of Pennsylvania.
- EDWARD J. MODEST, *Adjunct Professor of Medicinal Chemistry, 1968*
Ph.D., 1949, Harvard University.
- MARIO A. NICOTRA, *Adjunct Clinical Professor of Psychology, 1967*
M.D., 1941, University of Rome.
- DONALD K. PHELPS, *Adjunct Assistant Professor of Oceanography, 1969*
Ph.D., 1964, University of Rhode Island.
- SRECKO J. POGACAR, *Adjunct Assistant Professor of Pharmacology, 1969*
M.D., 1953, University of Ljubljana.
- JAN C. PRAGER, *Adjunct Associate Professor of Microbiology, 1967*
Ph.D., 1961, New York University.
- BENJAMIN H. PRINGLE, *Adjunct Associate Professor of Medicinal Chemistry, 1966*
Ph.D., 1947, Michigan State University.
- SUMNER R. ROBINSON, *Adjunct Associate Professor of Pharmacology, 1967*
Ph.D., 1961, Massachusetts College of Pharmacy.
- CHARLES S. SAHAGIAN, *Adjunct Assistant Professor of Chemical Engineering, 1970*
B.S., 1950, Boston College.
- KARL E. SCHAEFER, *Adjunct Professor of Zoology, 1965*
M.D., 1936, University of Kiel.
- GERALD SILVERMAN, *Adjunct Professor of Food and Nutritional Science, 1969*
Ph.D., 1954, Cornell University.
- EMORY G. SIMMONS, *Adjunct Professor of Botany, 1972*
Ph.D., 1950, University of Michigan.
- MOLLIE STEVENS SMART, *Adjunct Professor of Child Development and Family Relations, 1954*
Ph.D., 1970, University of Delhi.
- GERALD CARL SOLTZ, *Adjunct Assistant Professor of Chemical and Ocean Engineering, 1968*
Ph.D., 1966, Manchester University, England.
- LEO A. SPANO, *Adjunct Assistant Professor of Chemical Engineering, 1967*
M.S., 1948, University of Rhode Island.
- WILTON STURGES, III, *Adjunct Professor of Oceanography, 1966*
Ph.D., 1966, The Johns Hopkins University.
- CLARENCE M. TARZWELL, *Adjunct Professor of Plant Pathology-Entomology, 1965*
Ph.D., 1936, University of Michigan.
- CAROL J. THOMAS, *Adjunct Professor of Community Planning and Area Development, 1971*
M.S., 1948, University of Connecticut.
- GERALD E. ZAROOGIAN, *Adjunct Associate Professor of Food and Resource Chemistry, 1969*
Ph.D., 1963, Purdue University.
- RALPH ZIRKIND, *Adjunct Professor of Electrical Engineering, 1973*
M.S., 1946, Illinois Institute of Technology.

GRADUATE CLINICAL
APPOINTMENTS

RICHARD ANTONNELLI, *Clinical Associate in Psychology, 1969*

M.S.W., 1964, Boston College.

SARA V. FINCK, *Clinical Assistant Professor of Speech, 1973*

M.A., 1972, University of Rhode Island.

JOHANNA E. MOHRNHEIM, *Clinical Professor of Psychology, 1970*

M.D., 1949, University of Hamburg.

BARRY J. REGAN, *Clinical Assistant Professor of Speech, 1973*

Ed.D., 1967, Boston University.

ROGER A. RICHARDSON, *Clinical Assistant Professor of Psychology, 1967*

Ph.D., 1967, Louisiana State University.

HENRY S. M. UHL, *Clinical Professor of Health Sciences, 1971*

M.D., 1947, Harvard Medical School.

Graduate School Calendar

FALL SEMESTER 1973

September 4, 5, Tuesday, Wednesday

Graduate registration, 9:00 a.m. to 5:00 p.m., Tootell Gymnasium. Bills and fees for new students must be paid at the time of registration. There is a \$15 late fee for continuing students who did not register in April.

September 6, Thursday

Classes begin, 8:00 a.m.

September 20, Thursday

Final date for adding courses or for changing from audit to credit.

Final date for dropping courses without \$5 penalty fee.

Final date for January master's degree candidates to submit theses proposals.

October 8, Monday

Holiday, Columbus Day.

October 9, Tuesday

Due date in Princeton, N.J., for registration forms for October 27 ETS language examinations.

October 22, Monday

Holiday, Veterans Day.

October 26, Friday

Mid-semester.

Final date for June doctoral degree candidates to submit dissertation proposals.

Final date for dropping courses without grading.

October 27, Saturday

ETS language examinations in French, German, Russian and Spanish.

November 12 to 16

Graduate registration for 1974 spring semester, 9:00 a.m. to 4:00 p.m., Registrar's Office.

November 21, Wednesday

Thanksgiving recess begins, 5:00 p.m.

November 26, Monday

Thanksgiving recess ends, 8:00 a.m.

December 22, Saturday

Last day of classes.

Christmas recess begins, 4:50 p.m.

January 2, Wednesday

Christmas recess ends 8:00 a.m.

Final date for all January candidates to submit completed master's theses and doctoral dissertations in a form acceptable for examination purposes. *No extensions of time will be granted.* Oral defense examinations cannot be scheduled during the week of January 14. See note at end of calendar for rules on scheduling examinations.

Due date in Princeton, N.J., for registration forms for January 19 ETS language examinations at Brown University.

January 3 to 11

Final examinations.

January 14, Monday

Last day for grades, 9:00 a.m.

January 18, Friday

Final date for June master's degree candidates to submit theses proposals.

Final date for students admitted in September 1973 to submit programs of study.

January 19, Saturday

ETS language examinations in French, German, Russian and Spanish at Brown University.

SPRING SEMESTER 1974

January 21, 22, Monday, Tuesday

Graduate registration, 9:00 a.m. to 4:00 p.m., Tootell Gymnasium. Bills and fees for new students must be paid at the time of registration. There is a \$15 late fee for continuing students who did not register in November.

January 23, Wednesday

Classes begin, 8:00 a.m.

January 28, Monday, 9:00 a.m.

Final date for all January degree candidates to submit master's theses and doctoral dissertations, which have been successfully defended, in final form.

February 6, Wednesday

Final date for adding courses or for changing from audit to credit.

Final date for dropping courses without \$5 penalty fee.

March 8, Friday

Mid-semester.

Final date for dropping courses without grading.

March 15, Friday

Final date for August doctoral degree candidates to submit dissertation proposals.

April 9, Tuesday

Due date in Princeton, N.J., for registration forms for April 27 ETS language examinations at Brown University.

April 12, Friday

Spring recess begins, 12 noon.

April 22, Monday

Spring recess ends, 8:00 a.m.

Final date for all June degree candidates to submit completed master's theses and doctoral dissertations in a form acceptable for examination purposes. *No extension of time will be granted.* See note at end of calendar for rules on scheduling examinations.

April 22 to 26

Graduate registration for 1974 fall semester, 9:00 a.m. to 4:00 p.m., Registrar's Office.

April 27, Saturday

ETS language examinations in French, German, Russian and Spanish at Brown University.

May 11, Saturday

Last day of classes.

May 14 to 22

Final examinations.

May 24, Friday

Last day for grades, 9:00 a.m.

May 28, Tuesday, 9:00 a.m.

Final date for all June degree candidates to submit master's theses and doctoral dissertations, which have been successfully defended, in final form.

Final date for August master's degree candidates to submit theses proposals.

Final date for January doctoral degree candidates to submit dissertation proposals.

Due date in Princeton, N.J. for registration forms for June 15 ETS language examinations at Brown University.

June 2, Sunday

Commencement.

SUMMER SESSION 1974

See *Summer Session Bulletin* available at Summer Session Office.

June 15, Saturday

ETS language examinations in French, German, Russian and Spanish at Brown University.

July 4, Thursday

Holiday, Independence Day.

August 6, Tuesday

Final date for all August degree candidates to submit completed master's theses and doctoral dissertations in a form acceptable for examination purposes. *No extension of time will be granted.* See note at end of calendar for rules on scheduling examinations.

August 12, Monday

Holiday, Victory Day.

August 26, Monday

Final date for all August degree candidates to submit master's theses and doctoral dissertations, which have been successfully defended, in final form.

Note: oral defense examinations may be scheduled and conducted at any time during the fall and spring semesters. The examinations will be scheduled no sooner than ten days after delivery to the Graduate School Office of four copies of a thesis or dissertation acceptable for examination purposes. During Summer Session, special arrangements must be made with both the Graduate School Office and the department for scheduling oral defense examinations. Such examinations will be scheduled only at the convenience of participating faculty. Examinations will not be scheduled during recess periods (intersessions, Christmas and spring recesses).



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- 3 Art Studios D3
- 4 Athletic Bubble D1
- 5 Ballentine Hall *business administration* B3
- 6 Beck Field D1
- 7 Biological Sciences Building A3
- 8 Bliss Hall *engineering* B4
- 9 Career Planning and Placement (70 Lower College Rd.) C3
- 10 Catholic Center B4
- 11 Chafee Social Science Center A3
- 12 Child Development Center E3
- 13 Community Planning (36 Upper College Rd.) D4
- 14 Community Planning *studios* A7
- 15 Crawford Hall *chemical engineering* B4
- 16 Dairy Barn B2
- 17 Davis Hall C3
- 18 East Hall *physics* B4
- 19 Edwards Hall C4
- 20 Episcopal Center E3
- 21 Experimental Turf Plots B1
- 22 Faculty Center B4
- 23 Fine Arts Center B4
- 24 Fire Station B5
- 25 Fogarty Health Science Building *nursing and pharmacy* D3
- 26 Gilbreth Hall *industrial engineering* B4
- 27 Green Hall D4
- 28 Greenhouses A4
- 29 Home Management House E3
- 30 Horticulture Gardens A4
- 31 Independence Hall D4
- 32 Information and Police D3
- 33 International House B1
- 34 Keaney Gymnasium D1
- 35 Kelley Hall *electrical engineering* B4
- 36 Library B3
- 37 Library School, *graduate* (74 Lower College Rd.) C3
- 38 Lippitt Hall B3

- 39 Meade Field B2
- 40 Memorial Union D3
- 41 Morrill Science Building *life sciences* D3
- 42 Oceanography (19 Upper College Rd.) E4
- 43 Pastore Chemical Laboratory D3
- 44 Personnel and Purchasing (80 Lower College Rd.) C3
- 45 Planetarium B4
- 46 Police and Information (#32) D3
- 47 Potter Building *infirmiry* C2
- 48 Lower College Road No. 34 D3
- 49 Upper College Road No. 31 D4
- 50 Quinn Hall *home economics* C3
- 51 Ranger Hall *biological sciences* C4
- 52 Lower College Road No. 37 D3
- 53 Rifle Range B1
- 54 Rodman Hall B3
- 55 Roosevelt Hall C3
- 56 Sherman Building *maintenance* B1
- 57 Taft Hall B3
- 58 Tennis Courts A3, E1
- 59 Tooltell Physical Education Center C1
- 60 Tyler Hall *computer laboratory* A3
- 61 Upper College Road No. 85 C4
- 62 Upper College Road No. 95 C4
- 63 Wales Hall *mechanical engineering* B4
- 64 Washburn Hall C4
- 65 Water Towers A5, B4
- 66 Watson House B3
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- 72 Aldrich Hall B2
- 73 Barlow Hall D2
- 74 Bressler Hall D3
- 75 Browning Hall D2
- 76 Burnside Hall B2
- 77 Butterfield Hall *residence and dining* D3
- 78 Coddington Hall B2
- 79 Dorr Hall C2
- 80 Ellery Hall C2
- 81 Faculty Apartments E4

- 82 Fayerweather Hall C2
- 83 Gorham Hall C2
- 84 Heathman Hall A2
- 85 Hope Hall *dining* B3
- 86 Hopkins Hall C2
- 87 Hutchinson Hall C3
- 88 Merrow Hall B2
- 89 Peck Hall C3
- 90 President's House D4
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- 92 Student Apartments D3
- 93 Tucker Hall B3
- 94 Weldin Hall D2

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- 95 Alpha Epsilon Pi E2
- 96 Chi Phi D4
- 97 Lambda Chi Alpha E5
- 98 Phi Gamma Delta B3
- 99 Phi Kappa Psi E2
- 100 Phi Mu Delta E2
- 101 Phi Sigma Delta E2
- 102 Phi Sigma Kappa E4
- 103 Sigma Alpha Epsilon D4
- 104 Sigma Chi C4
- 105 Sigma Nu C4
- 106 Tau Epsilon Phi D4
- 107 Tau Kappa Epsilon D3
- 108 Theta Chi E4
- 109 Theta Delta Chi B3

Sororities

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- 111 Alpha Delta Pi E3
- 112 Alpha Xi Delta E2
- 113 Chi Omega E2
- 114 Delta Zeta E2
- 115 Sigma Delta Tau E2
- 116 Sigma Kappa E2

